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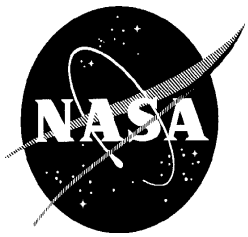
# Earth Science Data And Information System (ESDIS) Project Plan

**Original**

**April 1999**




National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

# Earth Science Data and Information System (ESDIS) Project Plan

April 1999

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# 1. INTRODUCTION

## 1.1 Summary

The overall goal of the Earth Observing System (EOS) Program is to advance the understanding of the entire Earth system on a global scale by improving our knowledge of the components of the system, the interactions among them, and how the Earth system is changing.

The Earth Science Data and Information System (ESDIS) Project will develop, implement, and operate a data and information system for NASA's Earth Science Enterprise (ESE) to support multidisciplinary research in global change and public data access. This system, called the EOS Data and Information System (EOSDIS), will be NASA's component of the interagency Global Change Data and Information System (GCDIS) to acquire, archive, manage, and distribute Earth observation data to a broad user community.

The ESDIS Project employs the Project Management Process as defined in NASA Procedures and Guidelines (NPG) 7120.5A, *NASA Program and Project Management Processes and Requirements.* Since this plan is being established subsequent to the completion of the Project Formulation and Project Approval subprocesses, this Plan will focus on the Project Implementation subprocess.

## 1.2 Background

The ESDIS Project has its genesis in the EOS Project Office (Code 420) established in 1990. At that time, the EOSDIS Core System (ECS) Project, managed and staffed by the Mission Operations and Data Systems Directorate (MO&DSD) as Code 502.2, was collocated with and operated under the programmatic direction of the EOS Project Office. In 1993, concurrent with the establishment of the Goddard Space Flight Center (GSFC) Mission to Planet Earth (MTPE) Office (Code 170), EOSDIS implementation and operation responsibility was consolidated in the MO&DSD under the management of the ESDIS Project operating as Code 505. During late 1996 the ESDIS Project was returned to the Flight Projects Directorate as Code 423.

The ESDIS Project has been operating under the EOS Execution Phase Project Plan until now. This new Plan provides a new baseline for the Project implementation subprocess that reflects redirection from a number of external reviews, programmatic changes, and organizational changes that have occurred. EOS has now become a cost-driven program.

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# 2. PROJECT OBJECTIVES

## 2.1 Project Goals and Objectives

The ESDIS Project goals are to:

a. Understand clearly and fully the needs of EOSDIS users

b. Implement and operate an EOSDIS that provides the greatest possible satisfaction of these needs within known program and budget constraints

c. Be responsive to changes in the needs of the users and in the program constraints

To achieve these goals, the ESDIS Project adopts the following objectives:

a. Interact effectively with program management and with the science community to specify, develop, and operate an EOSDIS that is mutually understood to reflect an optimum balance between needs and constraints.

b. Design an EOSDIS that 1) strongly considers the life-cycle cost of the end-to-end (flight and ground) data system for ESE, 2) is sufficiently robust and flexible to cost-effectively evolve as program and user requirements and characteristics change, and 3) can take advantage of technological opportunities as and when they become evident.

c. Develop, fabricate, integrate, and install the EOSDIS using techniques and methods that 1) assure achieving the documented requirements, 2) guarantee cost and schedule control, and 3) pro-actively manage all significant sources of risk.

d. Operate the EOSDIS reliably, efficiently, and responsively.

## 2.2 Performance Goals

To achieve the above goals and objectives, the ESDIS Project has the following three performance goals:

· Develop the EOSDIS Flight Operations System (FOS) that supports spacecraft operations during launch and throughout on-orbit operations

· Enable production of all approved EOS Level 0 through Level 4 data products

- Archive and distribute the Level 0 through Level 4 data products through the mission lifetime plus three years

## 2.3 Performance Indicators

To verify achievement of its goals and objectives, the ESDIS Project will monitor its performance using the following performance indicators:

- Adherence to a yearly development schedule and cost plan
- Production relative to a yearly production plan
- Effectiveness for meeting user requests for data

# 3. CUSTOMER DEFINITION AND ADVOCACY

The NASA Headquarters (HQ) Earth Science Enterprise provides ESDIS with its budget and in that sense could be considered the ESDIS customer. However, for the purposes of this discussion, the customers are the direct users of the systems and services developed by ESDIS and its partners on the EOSDIS Team and include the Flight Projects, Science Data Producers, and Science Data Users. While there is overlap in the customers of the ESDIS Science Systems and Mission Systems, it is useful to address them separately due to the unique sets of services that they provide.

## 3.1 Science Systems

The product flow for the ESDIS Project is relatively straightforward and serves to define customer relationships of the project. The EOS-G Program Office of the Earth Science Enterprise provides a budget to ESDIS to develop and operate the EOSDIS as a service to the community of producers and users of EOS and related Earth science data (Figure 3-1). The data producers are primarily Instrument Teams but also include providers of ancillary data. The ESDIS team, consisting of the civil servant staff, EOSDIS Core System contractor, and other support contractors, develops, integrates, and tests the baseline components and delivers them to the Distributed Active Archive Centers (DAACs). The DAACs are principally responsible for the operation of EOSDIS science systems but also may augment the system capabilities with DAAC-unique functions. The EOSDIS Team, which interacts with project customers, is comprised of the union of the ESDIS Team and the DAACs.

The product flow between the EOSDIS Team and the EOS data producers (see Figure 3-1) is dependent on the approach taken in producing the science data. In the case where the data processing is to be accomplished within the ECS baseline at the DAACs, ESDIS delivers a Science Data Processing Toolkit to the producers for their use in developing their algorithms. The algorithms are in turn delivered to the DAACs to be integrated into their data processing system. Alternatively, with Science Investigator-led Processing Systems (SIPS), some data producers may assume the responsibility for production of the data products, and in those cases the science data products will be delivered to the DAACs. In both data processing approaches, the DAACs have the responsibility for archiving and distributing the data to the user community.

## ESDIS Customer Interaction

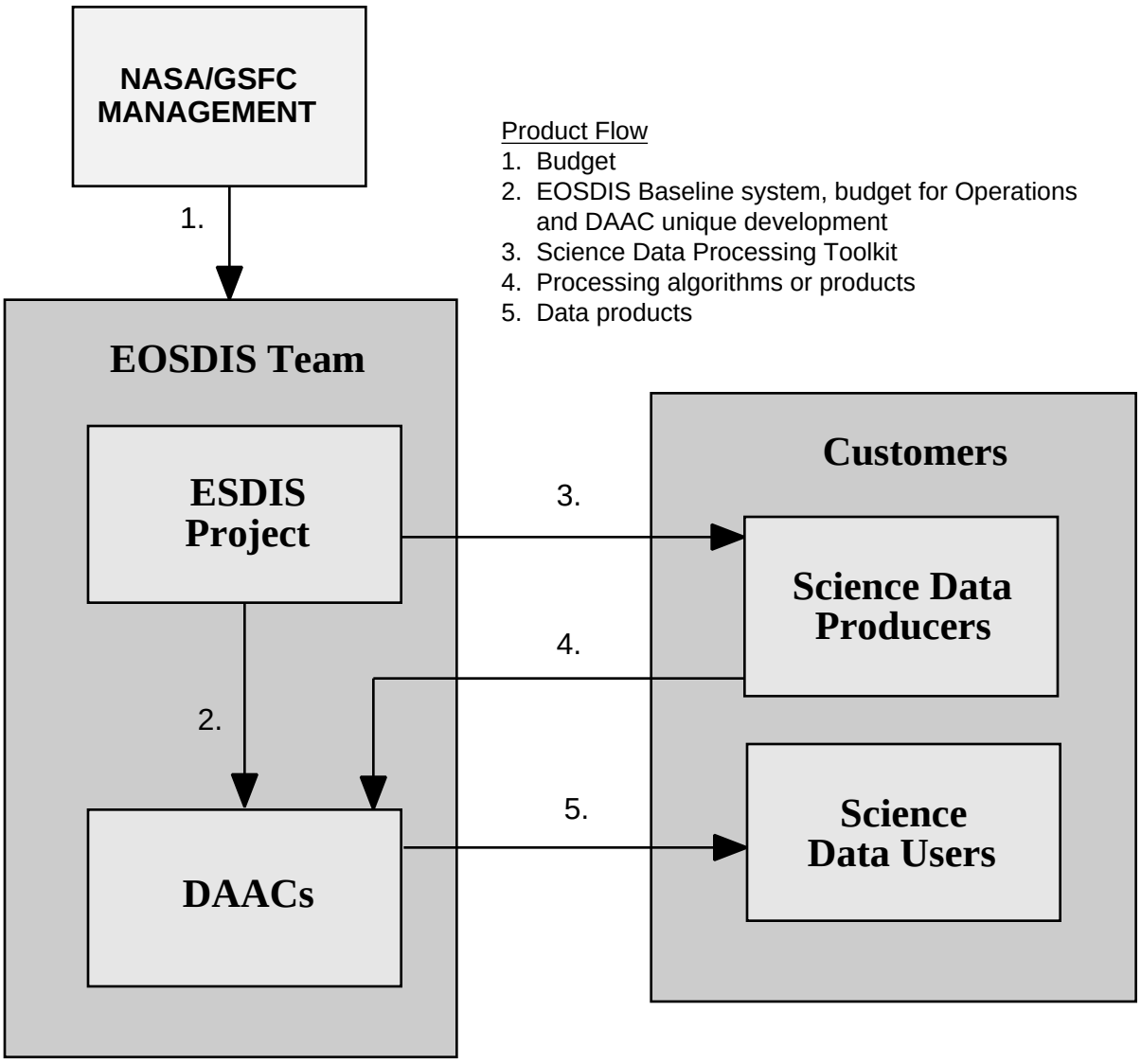


**Figure 3-1. EOSDIS-Customer Product Flow**

The information flow for the ESDIS Project is somewhat more complicated, as shown in Figure 3-2. To accurately describe these information flows one must include the various committees chartered by NASA HQ to advise on the development and operation of EOSDIS. These include the EOSDIS Review Group (ERG) formed by the Earth Systems Science and Applications Advisory Committee (ESSAAC), the EOS Investigator Working Group (IWG), the DAAC User Working Groups, and the EOSDIS Panel (a.k.a. Data Panel). In all cases, the ESDIS Project provides information on the status and plans of the EOSDIS development, and the advisory committees provide

recommendations to NASA HQ and GSFC management. For the ESDIS Project, the most direct relationship exists with the Data Panel, which was formed to directly advise the Project during the design and implementation of EOSDIS. Since the members of this committee are representatives of the ESDIS customers, the Data Panel can also serve to resolve conflicts in the feedback that emerges from the diverse community of EOSDIS users.

Another entity that must be shown in the ESDIS customer information flows is the Data Processing Resources Board (DPRB) whose members are the Project Scientists of ESDIS and the EOS Flight Projects. This board was formed to resolve requirement issues that can be reconciled without impact to the baseline budget and schedule for the ESDIS Project. This body can make recommendations to EOS Program management that may include new requirements, but it cannot give new requirements directly to ESDIS. The ESDIS Project will only accept new requirements from its NASA/GSFC management chain.

The flow of information among the members of the EOSDIS Team and its customers is a function of the activities of that member. The DAACs, as the operational arm of EOSDIS, will have an active and ongoing interaction with customers of EOSDIS data and services. The purpose of this communication is to inform the community as to the availability of these data and services and to receive feedback on the operational capabilities. The ESDIS Team also communicates with the user community to report on the status and plans of the EOSDIS development and to get feedback on those plans. Also shown in Figure 3-2 is a summary of the internal communications among the members of the EOSDIS team.

- The ESDIS Team has the responsibility for reporting to the general customer community on the status of the project and future directions.
- The DAACs, as the operational arm of EOSDIS for science systems, will have an active and ongoing interaction with EOSDIS customers in the performance of these duties.
- The customers are represented on the advisory boards that have been chartered by NASA and GSFC management to guide the development and operation of EOSDIS.

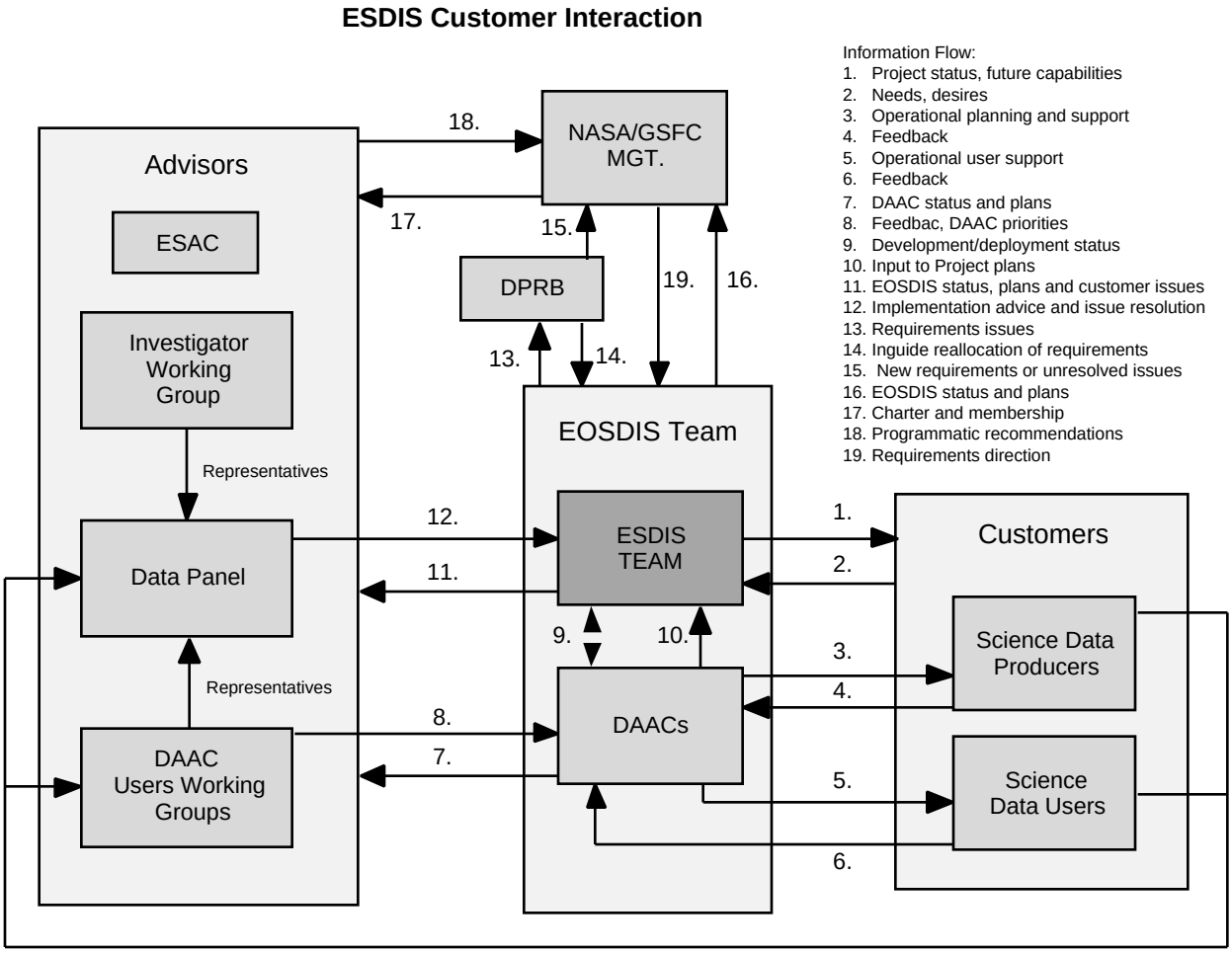


**Figure 3-2. EOSDIS-Customer Information Flow**

- The DPRB will try to resolve any requirement issues that can be reconciled without impact to the baseline budget and schedule for the ESDIS Project.
- While the EOSDIS Team encourages and track feedback from the customers and the advisory boards, any new requirements must come from the NASA/GSFC management chain.

## 3.2 Mission Systems

ESDIS Mission Systems personnel provide direct support to the EOS flight projects as early as the Mission Formulation phase in advanced mission definition and documentation of operations concepts and requirements. A designated Mission Systems manager works directly with the flight project. The Mission Systems manager

coordinates the support provided by ground system personnel based on spacecraft and instrument operations requirements, and works with flight project personnel, the spacecraft and instrument teams to ensure that mission-specific requirements are implemented for mission support. Mission systems personnel also support the flight projects in integrated spacecraft-to-ground system testing activities. A designated flight operations director (FOD) is responsible for training the Flight Operations Team (FOT); he/she directs the control center operations and the FOT during launch and early orbit, in accordance with direction from the Flight Project Manager or his/her designee. After successful on-orbit checkout of the spacecraft and instruments, responsibility for on-orbit operations is turned over to the Earth Science Mission Operations Project.

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# 4. PROJECT AUTHORITY

The ESDIS Project is managed by the Flight Projects Directorate, Code 400, GSFC. It receives its programmatic direction and resources from the EOS-G Program Office (Code 420). The ESDIS Project and the EOS-G Program Office jointly maintain a mission baseline that describes EOSDIS data products. The Project is funded by Unique Project Number (UPN) 428 "EOS Data and Information System (EOSDIS)."

The NASA Headquarters organization programmatically responsible for the EOSDIS is the Operations, Programming Planning and Development Division (Code YF) in the Earth Science Enterprise (Code Y).

In addition to managing the ESDIS Project, the Deputy Associate Director of Flight Projects for EOS Operations is also responsible for participating with the Chief, EOS-G Program Office in jointly managing the EOS Level 2 program.

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# 5. TECHNICAL SUMMARY

## 5.1 Requirements

This section presents an overview of the EOSDIS system-level functional and performance requirements. This information is intended to serve as a context and basis for the project organization, staffing, policies, and processes that are the primary subject of this document and not as a controlled baseline for implementation.

### 5.1.1 Requirements Heritage

EOSDIS is one of four major EOS Program elements:

1. A scientific research program that focuses on the utilization of EOS data.
2. Development, maintenance, and quality assurance of the science data production software (also referred to as the "algorithms") to generate the standard products.
3. A data and information system to perform command and control of the EOS spacecraft and instruments; processing of EOS data; data archiving, distribution and management of NASA Earth Science data (EOSDIS).
4. A space-based observing system consisting of multiple flights, with the goal of building a contiguous 15-year data set.

The EOS Program Commitment Agreement (PCA), as signed by the NASA Administrator, serves as the authorizing document for the Program and outlines the program-level requirements. The PCA presents the EOS mission profile; resource commitments; and key milestones for EOS Flight Missions and EOSDIS. Mission support and data management requirements for EOSDIS Versions 0 - 4 are also summarized.

Level 1 EOS Project requirements are defined and allocated to the GSFC in the Execution Phase Project Plan (EPPP) for Earth Observing System (EOS), Revision A, 170-01-01, May 1995. This document is referenced in the PCA as the "Project Plan." The EPPP allocates the GSFC Level 1 requirements among the various flight missions (AM, PM, Chem and special flights, Flights of Opportunity) and the EOSDIS.

The EOSDIS requirements defined in the EPPP serve as the baseline from which the Earth Science Data and Information System (ESDIS) Project Level 2 Requirements

are derived. The ESDIS Project Level 2 Requirements serve to allocate the Level 1 requirements to EOSDIS subsystems, and to further refine and derive functional and performance requirements in accordance with the needs of the EOS flight projects, instrument teams, and user community.

The ESDIS Project Level 2 Requirements consist of 7 volumes, 0 - 7, and include: (0) Overall, (1) EOSDIS Core System (ECS), (2) EOS Data and Operations System (EDOS), (3) Other, (5) Version 0, (6) EOSDIS Backbone Network (EBnet), and (7) EOS Polar Ground Station (EPGS). A supplementary document, ESDIS Project Mission Specific Requirements for the Landsat 7 Mission Level 1 Processing, presents the Landsat-7-specific processing requirements for which the ESDIS Project is responsible.

Level 3 requirements for the various EOSDIS subsystems are derived from Level 2 and constitute specifications and Statements of Work (SOW) for implementation. A key example is the Functional and Performance Requirements Specification for the EOSDIS Core System, Revision B, which serves as the contractual specification for the ECS contract.

Supplementing the ESDIS Project Level 2 Requirements is a series of Interface Requirements Documents (IRDs) among the ESDIS Project and various external organizations, including Landsat-7, TRMM Ground System, AM-1 Flight Operations, NSI, MITI ASTER Ground System, NOAA Affiliated Data Center, Science Computing Facilities, and others.

NASA institutional support requirements for EOS missions are defined in Project Service Level Agreement (PSLA) documents and provided through the Space Operations Management Office (SOMO).

### 5.1.2 Mission Profile

The EOS Mission Profile specifies the missions and instruments that fall under the EOS Program and that the EOSDIS is required to support. The Mission Profile appears in the PCA and in the EPPP. The EPPP defines the specific type of support required for each mission (i.e., forward/return-link processing, flight operations, science data processing, and/or data archival/distribution) and specifies additional sources of data to be archived and distributed by the EOSDIS. In general, the EOSDIS is required to provide the full range of support for EOS flight missions, such as AM-1, and only archival/distribution support for data from related Earth science missions. The ESDIS Project Level 2 Requirements Volume 0 provides a detailed baseline set of

mission support requirements as derived from the EPPP.

### 5.1.3 Requirements Overview

The EOSDIS requirements as documented in the EPPP can be summarized at a high level as follows:

a. Provide forward and return link data services for command and control of spacecraft and capture of science data, including Level 0 data processing.

b. Provide complete spacecraft and instrument command and control services for designated missions and instruments.

c. Provide science data processing and reprocessing services for generating science data products at Distributed Active Archive Centers (DAACs), using investigator-provided processing software ("algorithms"), or at Science Investigator-led Processing Systems (SIPS).

d. Provide data ingest services for receiving science data products from Science Investigator-led Processing Systems and other EOS-related data from various Earth science data centers.

e. Provide data archival and distribution services for EOS and other Earth science data, including advertising, query, and browse services designed to facilitate Earth science research.

f. Support transfer of data to long-term archival agencies for permanent storage beyond mission life plus 3 years.

g. Provide the communications and system administration infrastructure necessary to accomplish the above.

h. Provide operations and maintenance necessary to accomplish the above at the GSFC and at other sites as designated.

i. Interact with and support related research programs in support of the broader goals of global climate research.

#### 5.1.3.1 Functional and Performance Requirements

The requirements for the EOSDIS are documented in the ESDIS Project Level 2 Requirements. This section of the Project Plan is intended to give the reader a brief summary of those requirements and should not be construed as the controlling requirements.

Functional and performance requirements for the EOSDIS can be grouped into forward- and return-link services, flight operations, science data processing, data archival and distribution, and communications and system administration.

#### 5.1.3.1.1 Forward- and Return-Link Services

- Provide all forward- and return-link interfaces and processing capabilities needed for command and control and science data receipt.
- Provide the capability to perform forward- and return-link communications via the Space Network (SN), the EOS Polar Ground Network (EPGN), and other communications services as appropriate.
- Capture all telemetry data for EOS missions and generate Level 0 datasets by ordering, removing redundancies, and quality checking packets for each instrument.
- Make Level 0 datasets available to the DAACs and SIPS within 48 hours of observation, 99% of the time.Provide a backup archive for Level 0 (or equivalent) data in a separate location.
- Deliver not less than 95% of all payload data to the DAACs and the backup archive.

#### 5.1.3.1.2 Flight Operations

- Provide full command and control support for all EOS spacecraft and instruments during all mission phases, including integration and test, launch, and on-orbit.
- Support multiple missions simultaneously.
- Establish interfaces for the command and control of International Partner (IP) instruments on EOS spacecraft and EOS instruments on IP spacecraft.

#### 5.1.3.1.3 Science Data Processing

- Through a combination of DAAC production facilities and SIPS, produce and make available to the Earth science community the complete set of EOS standard data products.
- Perform science data processing and reprocessing to generate standard data products, using algorithms provided by the instrument investigators, to continue for 3 years after the end of the last EOS flight operations.

- At the DAACs, ingest for archival and distribution those standard data products produced at the SIPS.
- Generate all EOS standard data products at "keep up" rates, such that processing backlogs do not accumulate.
- Produce the highest priority standard data products from each flight no later than 3 months after launch. The remaining data products must be available no later than 2 years after launch.
- Provide for standard products to be produced either routinely or on-demand.
- Provide "toolkits" of software development services to the SCF development facilities to facilitate transport of the science production software to the DAACs.
- Support integration at the DAACs of new and updated science production software from the investigators.
- Provide for quality assurance of standard data products by the responsible investigators.

#### 5.1.3.1.4 Data Archival and Distribution

- Provide archival and distribution services for 3 years after the end of the last EOS flight operations.
- Archive all data products and associated data for the missions and instruments in the mission profile.
- Provide backup archival capability adequate to reproduce all standard products.
- Provide search, browse, and query services suited to Earth science research purposes.
- Distribute data upon request or per standing orders, electronically or via media; perform accounting and collect performance metrics.
- Make data available for shipping/transmission via media within 24 hours of request.
- Ingest, archive, and distribute or otherwise make accessible (e.g., via interoperability) selected Earth science data from other facilities.

#### 5.1.3.1.5 Communications and System Administration

- Provide communications services in support of:
- Instrument and spacecraft command and control and health and safety (ground terminals - EOC, EOC - ISTs, EOC - International Partner ICCs)
- Receipt and distribution of science telemetry data (ground terminals - EDOS - science data production sites)
- Distribution of science data products and related data (DAAC - DAAC, DAAC - users, DAAC - SCF, DAAC - ADC, etc.)
- Provide network management capabilities adequate to ensure that the performance, availability, and security of all communications circuits are consistent with the function supported by the circuit.
- Allow for communications capacity growth.
- Perform monitoring functions across all data production facilities and networks to ensure that science data processing goals (as set by the EOS science team) are met.

### 5.1.3.2 External Interface Requirements

The EOSDIS is characterized by the number and complexity of its interfaces, both internally and externally. The System Interface Control Plan for the ESDIS Project, (latest approved version), identifies 29 interface documents at the IRD level and 67 at the ICD level. The complete list of interfaces and their corresponding EOSDIS support requirements are outside the scope of this document. The following summarizes the major EOSDIS external interfaces that drive the design and management of the system.

Note that the system consisting of the EOSDIS integrated with the external ground system components is referred to collectively as the EOS Ground System (EGS).

#### 5.1.3.2.1 EOS Spacecraft

The EOSDIS must ingest a continuous flow of science data from EOS spacecraft and instruments at very high aggregate data rates (e.g., greater than 10 Mbps, exact rates depending on number of concurrent missions). The volume of data that EOSDIS must ingest and process, while keeping up with the input data rate, is a significant design driver for the system.

The EOSDIS must interface with EOS spacecraft and instruments for commanding, loading flight software, and real-time health and safety monitoring.

Prior to launch, the EOSDIS must interface with the EOS spacecraft ground support facility during the spacecraft integration and test phase.

#### 5.1.3.2.2 Users

The EOSDIS must provide access to EOSDIS data for users at DAACs, SCFs, or their own facilities. All users must see a common view of the entire database of EOSDIS holdings. Browse, query, and ordering services shall be designed in coordination with the science user community to facilitate Earth science research.

#### 5.1.3.2.3 Science Data Processing Software

Science data processing software, which implements the scientific algorithms for the production of standard data products, is developed by the individual Instrument Teams (for facility instruments) and Principal Investigators (for PI instruments) at their SCFs; when production is to be performed at the DAACs, the software is then delivered to designated DAACs where it is integrated into the ECS production environment. The DAACs carry out routine production operations to process/reprocess the EOS standard data products using the investigator-supplied algorithms.

#### 5.1.3.2.4 Science Computing Facilities (SCFs)

The Science Computing Facilities (SCFs), located at EOS investigator facilities, are used for a variety of purposes including to: develop and maintain science data processing software for standard product generation; perform quality assurance on production output from the DAACs; produce standard products; provide instrument support; and perform other EOS-related scientific analysis functions.

Toolkit software developed under ECS is used at the SCFs to simulate the computing environment of the DAACs. This facilitates porting of the algorithms to the DAACs for production operations. For those SCFs involved in instrument operations, ECS provides an Instrument Support Toolkit (IST) at the SCF, which allows communications with the EOC and enables receipt and analysis of spacecraft operations data, instrument engineering data and memory dumps, planning and scheduling, instrument command requests to the EOC, etc.

#### 5.1.3.2.5 Science Investigator-led Processing Systems (SIPS)

In addition to the DAACs, which are funded by the ESDIS Project for the primary purpose of producing and distributing EOS standard data products and related data, other facilities known as Science Investigator-led Processing Systems (SIPS) will also produce EOS standard data products. Products will be produced at SIPS using investigator-provided systems and software and then sent to appropriate DAACs for archival and distribution (as distinct from products produced at DAACs, which use the EOSDIS Core System (ECS) and investigator-provided science production software). IRDs, ICDs, and Working Agreements will be developed to define the interfaces between SIPS and DAACs and to specify performance and quality requirements for products produced by the SIPS with funding from the ESDIS Project.

Under the “adaptive approach” to data processing as used by the ESDIS Project, the production of standard data products is allocated among DAACs and SIPS on cost/benefit basis, with the ESDIS Project performing the necessary cost analyses and the final decisions being made at the EOS Program level.

The SIPS are generally, but not necessarily, collocated with the PI/TL’s SCF. The management of the SIPS interfaces comes under the External Development and Interfaces Office of the Project.

#### 5.1.3.2.6 Other Facilities and Data Centers

The EOSDIS must interface with a number of other project and institutional data systems to ingest, archive, distribute, or otherwise provide access to their data. Significant interfaces of this type include the following:

TRMM Science Data and Information System (TSDIS)

The EOSDIS TRMM Support System (TSS) ingests TRMM data products from the TSDIS for archival and distribution and returns data to TSDIS upon request for reprocessing. The TSS is part of the GSFC DAAC.

Landsat-7 Facilities

The EOSDIS interfaces with the Landsat data processing facility at EDC to ingest ancillary data products from the Landsat-7 Image Assessment System (IAS), Level 0R data products from the Landsat-7 Processing System (LPS), and metadata and browse data from the International Ground Stations (IGSs). These products are

archived and distributed via the EDC DAAC.

DAS

The Data Assimilation System (DAS) collects data from EOSDIS, NOAA, and other sources and assimilates them into large-scale, multi-parameter global models that EOSDIS ingests for archival and distribution via the GSFC DAAC.

NOAA

EOSDIS must provide EOS instrument data for operational use by NOAA, within three hours of the actual observation time, at an EDOS communications interface.

In addition, EOSDIS interfaces for data exchange with NOAA's NESDIS Satellite Active Archive (SAA), the NESDIS Long-Term Archive (LTA) for ocean and atmospheric data, and the National Center for Environmental Prediction (NCEP).

Jet Propulsion Laboratory (JPL)

The JPL Physical Oceanography DAAC is required to ingest, archive, and distribute SeaWinds, QuikScat, and Jason data products from the respective JPL data systems for those missions.

International Partner (IP) Ground Systems

The International Partners (IPs) provide instruments to fly on EOS platforms. For these instruments, EOSDIS must interface with the respective IP ground systems (e.g., Japan's MITI ASTER Ground Data System (GDS) and NASDA Earth Observation Information System (EOIS)) for payload planning and integration, mission management, and payload command and control as well as processing and exchange of data and information.

Other data will be shared among the IPs in accordance with MOUs, including data products from ADEOS (Japan), TRMM (Japan and US), and POES (NOAA).

Cooperating Data Centers

The EOSDIS is required to interface with various other data centers for the exchange of science data needed for production processing and to provide users of EOSDIS

with access to data at those data centers. There are several such data centers within the U.S. and abroad.

General External Interfaces

The EOSDIS is designed as an open system that can interface readily with external data systems as the need arises.

#### 5.1.3.2.7 Space Operations Management Office (SOMO) Services

The EOSDIS must use NASA institutional services provided by SOMO in conformance with existing standards. These services include the TDRSS Ground Terminals, the Network Control Center (NCC), the Ground Network (GN), and Flight Dynamics System (FDS) services. Institutional support requirements for the EOS program are specified in Project Service Level Agreement (PSLA) documents.

### 5.1.4 System Architecture Requirements

In order to sustain operations over a 20-year-plus period, while adapting to changing user requirements and new technology, the EOSDIS is required to employ a distributed, modular, open system architecture designed to allow evolvability, technology insertion, and reuse of software/ hardware components among GCDIS facilities and the science community. Features of this architecture include:

- Application Programming Interfaces (APIs) to facilitate use of ECS functions at DAACs and other facilities
- Standard data exchange formats, protocols, and user access interfaces
- Capabilities that can be expanded and contracted to meet changing workloads and mission profiles
- Loosely coupled system elements, to the maximum extent possible
- Use of COTS products to the maximum extent possible.

### 5.1.5 Supporting Services

The ESDIS Project provides general support services related to EOSDIS, including: assistance to users of the EOSDIS; support for the preparation and delivery of new data products for ingest by EOSDIS; support for the development and deployment of DAAC-unique systems; encouragement and facilitation for the active participation of the science community in the design of EOSDIS services; assessment of user satisfaction on a continuing basis; assistance to outside organizations on EOSDIS-

related matters.

## 5.2 Systems Overview

The EOSDIS comprises a widely distributed, open architecture, end-to-end data system for command and control of EOS spacecraft and instruments; for receipt, capture, and Level 0 processing of telemetry data; and for production, archival, and distribution of science data. It includes the communications and administration infrastructure necessary to "glue" the system together and monitor its operation.

The major components of the EOSDIS are described in the following sections.

### 5.2.1 EOSDIS Core System (ECS)

The EOSDIS Core System (ECS) is a major component of the EOSDIS, providing the “core” common capabilities to meet EOSDIS requirements for spacecraft and instrument planning, scheduling, command and control; and for science product generation, information management, data archival and distribution.

The ECS consists of broad functional areas, or segments, for science data processing, archival, and distribution; flight operations; and communications and systems management.

#### 5.2.1.1 ECS Science Data Processing

The science data processing segment of the ECS provides hardware and software for producing EOS standard data products from Level 0 and other input data, using science production software (“algorithms”) provided by the instrument investigators. The data are reprocessed as necessary as algorithms are updated. (Other standard data products are produced at SIPS independently of ECS, then shipped to DAACs where they are handled similarly to ECS-produced products.) The data produced are archived and made available to users via an information management system that provides Earth science-specific data search and order capabilities. Users access data via EOSDIS client software. The ECS provides a software toolkit for algorithm developers to facilitate porting of the production software from the developer’s system (typically an SCF) to the production environment within ECS running at a DAAC. The science processing cpu workload and output volume are significant design and cost drivers for the EOSDIS.

#### 5.2.1.2 ECS Flight Operations

The flight operations segment of the ECS provides the mission operations support capabilities for the EOS spacecraft and instruments. This segment consists of two major components, the EOS Operations Center (EOC) and the Instrument Support Terminals (ISTs).

The EOC, located at the GSFC, is responsible for spacecraft and instrument command and control, health and safety, mission operations analysis, planning and scheduling, and overall coordination and merging of all instrument and spacecraft commands. The EOC is designed to support multiple spacecraft during various stages of developmental and on-orbit operations. Architecturally, the EOC consists of a number of loosely coupled subsystems, or services, to perform planning and scheduling, command management, commanding, telemetry processing, spacecraft analysis, data management, resource management, and real-time contact management; and to provide a user interface for the flight operations team.

The Instrument Support *Terminals* are workstations, located at Principal Investigator and facility instrument Team Leader facilities, that run the ECS-provided Instrument Support *Toolkit*. (Note that both may be referred to as ISTs in different contexts.) The Instrument Support Terminal provides remote access to the EOC functions for the purpose of scheduling, monitoring, and analysis for a specific instrument.

#### 5.2.1.3 ECS Communications and Management

The communications and system management function of ECS provides for interfacing with external networks, management of site-specific network/communications services, system configuration management, fault and security management, distribution and management of software licenses, and related system-wide administrative functions.

### 5.2.2 EOSDIS Version 0

EOSDIS Version 0 was the first in a series of versions in the evolutionary development of EOSDIS. Its development started in 1991 with the goal of providing a “working prototype with operating elements” to support the Earth science user community with convenient access to existing data at the DAACs and at NOAA’s Satellite Active Archive (SAA). It prototyped the interoperability of heterogeneous data systems to facilitate searching and ordering data without the user’s needing to know or specify the source data center. Declared operational in late 1994, Version 0 has been serving a broad user community through the EOSDIS DAACs and has provided EOSDIS developers with valuable user feedback. Since its initial deployment, Version 0 has

been extended to interoperate with non-EOSDIS data centers nationally and internationally. ECS will be interoperable with Version 0 for the purposes of data browse, search, and order.

### 5.2.3 EOS Data and Operations System (EDOS)

The EDOS is responsible for data capture from the spacecraft, interface of uplink commands, processing and distribution of Level 0 data products, and archival of Level 0 data. It provides the interfaces for uplink and downlink of data to the TDRSS ground terminal and to the EOS polar ground stations.

The EDOS consists of four distinct facilities:

a. Ground Station Interface Facilities (GSIFs), which interface with TDRSS and the two polar EOSDIS ground stations to store and forward return link data;

b. the Data Archive Facility (DAF), for archival of Level 0 (or equivalent) data;

c. the Level Zero Processing Facility (LZPF), for producing Level 0 products (both normal production and expedited) and handling real-time and uplink data; and

d. the Sustaining Engineering Facility (SEF), which provides a test and development environment, operations management services, and system support.

### 5.2.4 Distributed Active Archive Centers (DAACs)

There are eight geographically dispersed EOSDIS Distributed Active Archive Centers (DAACs), collocated with other institutional facilities to achieve science synergy with the ongoing activities of those institutions. Each DAAC is a science data processing center responsible for EOSDIS data management and user services functions within a particular discipline area (See Table 5-1). These functions include receiving EOS Level 0 data from EDOS; receiving science software from EOS instrument teams and integrating that science software into an operational production environment; performing processing and reprocessing of EOS standard data products following Project/Program Scientists' priorities; supporting instrument teams as necessary in performing quality assurance of standard data products; ingesting standard data products produced at SIPS; cataloging, archiving, and distributing EOS standard data products and other NASA Earth science data; providing data and information services and user support to the EOSDIS user community; and preserving complete

documentation of EOS data, instrument calibration, processing history, processing source code, etc.

**Table 5-1. DAAC Summary**

| DAAC | Science Disciplines | Mission/ Platform | Instrument/ Experiment |
|---|---|---|---|
| Alaska SAR Facility (Univ. of Alaska, Fairbanks) | Sea Ice and Polar Processes (Synthetic Aperture Radar) | ERS & JERS series<br><br>RadarSat | SAR<br><br>SAR |
| EROS Data Center (USGS) | Land Processes | AM<br><br>Landsat-7 | ASTER, MODIS (L2+/land)<br>ETM |
| Goddard Space Flight Center (NASA) | Upper Atmosphere, Atmospheric Dynamics, Global Biosphere | TRMM<br><br><br>SEASTAR<br>ADEOS-I<br>AM & PM series<br>PM series<br><br>Laser Alt.<br>CHEM<br>Flight of Opp.(FOO) | VIRS (a/d), PR (a/d), TMI (a/d), GV (a/d)<br>SeaWiFS<br>TOMS (a/d)<br>MODIS<br>AIRS, AMSU, MHS, AMSR<br>GLAS (L0/1)<br>HIRDLS, MLS<br>SOLSTICE III |
| Jet Propulsion Laboratory (JPL) | Physical Oceanography | ADEOS-I<br>QuikSCAT<br>ADEOS-II<br>Jason-1 | NSCAT (a/d)<br>Seawinds<br>JMR, DFA, MR |
| Langley Research Center (NASA) | Radiation Budget, Aerosols, Tropospheric Chemistry, Clouds | TRMM<br>AM<br><br>AM<br>PM series<br>FOO<br>FOO<br>FOO, Meteor, and Space Sta.<br>CHEM | CERES<br>CERES, MISR, MOPITT<br>CERES, MISR, EOSP<br>CERES<br>ACRIM<br>SAGE III<br><br><br>TES |
| National Snow and Ice Data Center (U. of Colorado) | Snow and Ice, Cryosphere and Climate | AM, PM<br>PM<br>ICESat | MODIS<br>AMSR<br>GLAS (L2+) |
| Oak Ridge National Laboratory (DOE) | Biogeochemical Dynamics | None | None |
| Socio-Economic Data Applications Center | Human Interactions in Global Change | None | None |

The DAACs use a combination of ECS-provided hardware/software systems and DAAC-unique capabilities to ingest, process, archive, and distribute the data for which they are responsible.

### 5.2.5 EBnet/NSI

The EOSDIS Backbone Network (EBnet), together with the NASA Science Internet (NSI), provide the broad and diverse communications necessary to support EOSDIS including: forward- and return-link communications for flight operations; high-capacity circuits for transport of science data from ground terminals to EDOS to the DAACs; inter-DAAC communications in support of science data production; circuits to SCFs for data quality assurance and/or instrument support; communications with other SCFs, Cooperating Data Centers (i.e., Affiliated Data Centers and Other Data Centers), International Partner (IP) data centers, etc.; and general user access to EOSDIS data and services at the DAACs.

In general, EOSDIS internal communications (e.g., DAAC - DAAC, EDOS - DAAC) are provided under EBnet while external communications (e.g., general user access, EOSDIS - Cooperating Data Center) are provided under NSI. All NASA communications services, including those provided by EBnet and NSI, fall under the general auspices of the NASA Integrated Services Network (NISN).

### 5.2.6 EOS Polar Ground Stations (EPGS)

The EOS Polar Ground Stations (EPGS) provide X-band receive capabilities for science data dumps and S-band TT&C capabilities for Landsat-7, EOS, and other Earth Science Enterprise (ESE) spacecraft. The EPGS consists of a Svalbard Ground Station (SGS), located in Svalbard, Norway, and an Alaska Ground Station (AGS), located in Poker Flat, Alaska. These stations include several major architectural components: the radio frequency subsystem, baseband data processing subsystem, monitor and control subsystem, and commercial telecommunication subsystem. The stations also house ground system interface facilities (GSIFs), provided by EDOS.

### 5.2.7 EOS Test System (ETS)-Multimode Portable Simulator (MPS)

The ETS-MPS provides a source of simulated CCSDS data to support testing of forward-link and non-science return-link processing.

### 5.2.8 Internal Interfaces

The external interface requirements for the EOSDIS were presented in Section 5.1. The internal interfaces among the major EOSDIS components are summarized in Table 5-2.

**Table 5-2. EOSDIS Major Internal Interfaces**

| Interface | Data |
|---|---|
| EDOS - DAACs | Level 0 and 1A archival data products, DAAC data requests |
| EDOS - EOC | Up-link/down-link command and low-rate real-time data |
| DAAC - DAAC | Science data for production, user queries and data orders |
| IST - EOC | Instrument health and safety and command data |
| EOC - ETS | Simulated telemetry and command data |
| DAAC - SIPS | Science data for production input, science data for archiving and distribution |

## 5.3 Operations Concepts

This section provides a technical summary of the operations concept for the Earth Observing System Data and Information System (EOSDIS). The operations concepts flow from the requirements and the systems design as stated above. The operations concept of the EOSDIS is to acquire, process, organize, archive, and distribute Earth science data and products to the broad science and user community. To achieve this, the ESDIS Project operates a number of systems, facilities, and spacecraft.

The ESDIS Project is a multimission project that provides mission support to the AM-1, PM-1, Chem, and ICESat missions. The ESDIS project provides science processing, archiving, and distribution for a broader set of missions that include TRMM, Landsat 7, SAGE, and RadarSat. The operational science processing elements for the Project are the Distributed Active Archive Centers (DAACs) and the Science Investigator-led Processing Systems (SIPS). The operations of the ECS for the ESDIS Project can be viewed from a "push" (ingest, production, and archiving) and "pull" (information discovery and retrieval) point of view.

### 5.3.1 Acquisition

The acquisition of science data can take a number of forms. For AM-1, PM-1, and Chem, the ESDIS project conducts the mission operations and manages the day-to-day acquisition of data through the TDRSS network and the EPGS. This acquisition involves planning the spacecraft and instrument operations, downlinking the data, and producing a Level 0 product that removes all downlink and acquisition artifacts. The Level 0 products are forwarded to the appropriate DAACs for higher-level processing, product development, and archiving. The Level 0 data can also be made available to Science Computing Facilities or other operational organizations as specified in special agreements. The acquisition of this data is driven by a Long Term Science Plan for each mission developed by the Project Scientist, Instrument Working Group, and instrument support personnel. This plan is translated into a weekly plan that is executed by the Flight Operations Team for the particular project.

For a number of missions, the ESDIS Project contracts for the acquisition of data from other satellites, such as TRMM, provides higher-level processing, and archives the data in the appropriate DAAC for distribution to approved users. The ASF DAAC acquires data from a number of foreign Synthetic Aperture Radar spacecraft and makes this available to approved science users.

A third acquisition mechanism is the collection of previous mission data sets from projects and PIs in the V0 data archive system. These data sets include data holdings for past missions that are made available to a DAAC for distribution to a user community. The present plan is to maintain the V0 data system at the existing DAACs.

### 5.3.2 Processing

The ESDIS project supports two distinct processing options for producing standard products from EOS instrument data. These are: 1. Processing at one or more of the DAACs under an EOSDIS Core System environment and 2. Processing at a Science Investigator-led Processing System (SIPS) facility. The choice between these two options is made, in the case of each instrument, through evaluation of proposals from and detailed discussions with the responsible instrument Principal Investigator or Team Leader.

With the first option, the responsible instrument teams deliver the science software to a DAAC for integration and testing. Routine production is carried out at the DAAC. The science software may include automatic quality assessment (QA) and/or means of identifying data that need to be sent to the IT's SCF for QA. The QA information is then

sent to the DAAC for incorporation in the product's metadata for archiving. Updates to QA information may be provided at any time.

With the second option, the products are generated at a location of the PI's/TL's choice, under more direct control of the PI/TL. The products along with the QA information are sent to the appropriate DAAC(s) for archiving. Updates to QA information may be provided at any time.

In either option, the ESDIS Project works closely with the instrument teams to make arrangements with the appropriate external agencies to provide the ancillary data needed for product generation. Generally, the ancillary data are provided for use in the product generation software by first getting the data to a DAAC and archiving them within the ECS environment. Exceptions to this approach are made in cases where it is simpler to do so.

### 5.3.3 Organize

ESDIS Project operations must deal with unprecedented volumes of science data. A key challenge is to organize the data from a logical and performance base so that the data can be processed, stored, and retrieved efficiently.

### 5.3.4 Archive

The initial data set archived by the ESDIS Project is the level 0 data set. From this data set the corresponding higher lever products are developed and then these products are archived. The DAACs routinely audit their data archive holdings to determine the health and status of the data in the archive; to validate the product inventory; and to maintain the long term viability of the archive.

A physically separate back-up archive is also provided for Level 0 data to protect against accidental or catastrophic data loss. Archived data are checked regularly to determine whether the data have degraded beyond the error limit set for the archive medium. The data are refreshed if the error limit has been exceeded, and a second check is made to determine whether the data are corrupted. If the data are corrupted, the metadata are updated to reflect the change in quality and DAAC operations personnel take the appropriate corrective actions to either reprocess the data from the level 0 data set or obtain a new copy of the level 0 data set.

**Table 5-3. End-To-End EOSDIS Operations Concepts**

| Mission Phases | Mission Operations Areas | | | |
|---|---|---|---|---|
| | S/C Operations | Instrument Operations | Data Operations | End User Operations |
| Players: | FOT | IT, IOT | IT, PIs | Users |
| **Launch Phase** – From approximately 24 hours pre-launch to spacecraft separation from the launch vehicle | EDOS, EOC, FDS, NCC | EDOS, EOC, ICCs, ISTs | N/A | N/A |
| **Activation Phase –** From spacecraft separation to completion of on-orbit checkout of spacecraft and instruments and instrument calibration | EDOS, EOC, FDS, NCC | EDOS, EOC, ICCs, ISTs | LZPF, DAACs, DAF, SCFs | N/A |
| **Routine Ops Phase** – From end of Activation Phase to End of Science Mission | EDOS, EOC, FDS, NCC | EDOS, EOC, ICCs, ISTs | LZPF, DAACs, DAF, SCFs, ADC/ODC | DAACs |
| **Deactivation Phase –** From end of Routine Operations to completion of spacecraft deactivation | EDOS, EOC, FDS, NCC | N/A | N/A | N/A |

Note: EBnet, Ground Stations, etc. are not shown for clarity.
N/A – Not Applicable

The data in the EOSDIS archives will be transitioned to long-term archival agencies for permanently archiving and supporting users long after the EOS mission. Transition of some of the heritage Earth science data has already begun. Arrangements have been made with the USGS for long-term archiving of the Land processes data and are being worked out with NOAA for oceanic and atmospheric data.

### 5.3.5 Distribute

The EOSDIS DAACs provide a wide range of services that enable users to efficiently and effectively interact with the EOSDIS to place orders for products. These include services to: register as a user; obtain help and tutorial support; search and query data holdings; browse and order existing data granules; request acquisition of specific data; determine the status of orders; and receive products.

There are two basic types of orders processed by the DAACs: subscription orders and retrospective orders. Subscription order processing allows users to request, in

advance of events within the system such as acquisition and data product generation, all standard data products that meet their specified criteria. Whenever a user has entered a subscription order into the system, the requested standard data products are staged for delivery as they are produced. They are delivered to the user each time the user-specified criteria are met. The user needs to take no further action.

Retrospective order processing allows users to order a data product from a list of existing and virtual products. A virtual product appears as an existing product to a user since metadata exists to describe it, but the product is only produced when an order is received for it.

### 5.3.6 Special Operations

Special operations consist of launch and early orbit operations and special campaigns. For the missions that the ESDIS Project operates the spacecraft, the ESDIS Project works with the flight project to develop an activation timeline, ensures that all procedures are in place, and conducts interface tests and mission simulations. The ESDIS Project acts as system integrator of the ground system for the flight project and ensures that a complete, tested, operational system is ready to support launch and activation of the mission.

In order to supply this support, the ESDIS Project provides systems and facilities to the flight project's team for the launch and early orbit period. The ESDIS Project provides all institutional interfaces and ensures that these interfaces are functioning.

Similar support is provided for special on-orbit operations critical to mission support. This involves special calibration maneuvers, orbit adjust maneuvers, and spacecraft safings. The ESDIS Project maintains ties to the appropriate technical organizations to ensure that the appropriate skills can be brought together to support these types of activities.

### 5.3.7 Spacecraft Operations

At the completion of on-orbit validation, the responsibility for spacecraft operations will be turned over to the Earth Sciences Mission Operations Project, Code 428.

### 5.3.8 Instrument Operations

Instrument operations are defined as all operations that affect the instruments on the spacecraft. These include instrument planning, calibration, control, pointing, and health and safety monitoring. The individual Instrument Teams (ITs) are responsible for instrument operations. All phases of instrument operations occur at the EOC.

Instrument telemetry is monitored for health and safety of the instrument, and command uplinks are initiated. Operations plans and instrument engineering and science data are exchanged between the EOC and the Instrument Control Center (ICC) or Instrument Support Terminal (IST).

During the launch phase, instruments are powered off except for unique cases such as environmental concerns. In these cases, the health and safety of the instrument is monitored.

During the activation phase, instruments will be activated and calibrated when it will not be a threat to the health and safety of the spacecraft. Instrument operations will be autonomous and controlled by stored commands in the spacecraft. Instrument engineering, calibration, and/or science data are routed to the appropriate ICC, IST, and the DAAC.

During the routine operations phase, instruments are operated autonomously by stored commands. The EOC, ICC, and IST monitor the health and safety of the instrument. The planning and scheduling function allows for targets of opportunity to be scheduled so that any unusual events can be observed.

There are no instrument operations for a spacecraft during the deactivation phase.

### 5.3.9 Data Operations

Data Operations are defined as all operations that involve the science data. This includes data transfer, ingest, archiving, processing, and cataloging. Personnel at the DAAC and the IT and the PI are responsible for data operations. The data operations concept is to accumulate, process, and store Earth science data and to make the data easily available to a wide community of scientists and users. Level 0 data is ingested at the DAAC from the Level Zero Processing Facility (LZPF) in the EDOS and then archived. Level 0 data are distributed by the DAACs to those SIPS that will process the data. The science data are then processed by the DAACs and SIPS into higher level data sets that are catalogued and archived at the DAAC.

During the activation phase calibration data is processed at the DAAC and/or Science Computing Facility (SCF) for each instrument. The calibration data will be cross calibrated with previous instruments data so that processed data sets will have related units of measurement.

The routine data operations also include ingesting of non-EOS data from Cooperating Data Centers, e.g., Affiliated Data Centers (ADCs) and Other Data Centers (ODCs). These data are also catalogued and archived and made available at the DAAC.

There are no data operations for a spacecraft during the launch phase and deactivation phase.

### 5.3.10 User Operations

User operations are defined as any search or access of Earth science data. User operations are available at any time during the operation of the EOSDIS. The user's interface to the data is at the DAAC via the Internet from the user's workstation or SCF. The DAACs provide services to assist users in data acquisition, search, access, and usage. Users may browse for data that they are interested in and may then request the data for download or shipment.

There are no user operations for a spacecraft during the launch, activation, and deactivation phases
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# 6. MANAGEMENT

## 6.1 ESDIS Project Management Responsibilities and Organization

Management responsibilities and procedures for the ESDIS Project are established in accordance with NASA Program and Project Management Processes and Requirements, NPG 7120.5A, dated April 3, 1998, and with GSFC's Project Management, GPG 7120.2. The ESDIS Project Staff interfaces with functional GSFC directorates and facilities to plan, implement, and coordinate development of the EOSDIS. The Project organization chart is shown in Figure 6-1.

### 6.1.1 ESDIS Project Manager (PM)

The ESDIS Project organization shown in Figure 6-1 is headed by the Deputy Associate Director of Flight Projects for EOS Operations, the senior official at GSFC exclusively responsible for managing execution of the project life cycle. The ESDIS Project Manager has full authority to carry out the responsibility within guidelines assigned by the Associate Director of Flight Projects for EOS.

Specific responsibilities include directing and overseeing:

- Fulfillment of customer needs through execution of project plans by government, contractor, and university participants in conformance with all project commitments and constraints and with all agency policies;
- Preparation and maintenance of project plans, specifications, schedules, and budgets;
- Acquisition and utilization of participating contractors;
- Performing project level SE&I; and,
- Reporting project status and contractor performance as required.

The ESDIS Project Manager discharges the responsibilities with the assistance and support of individuals and organizations assigned either administratively or functionally to the Project.

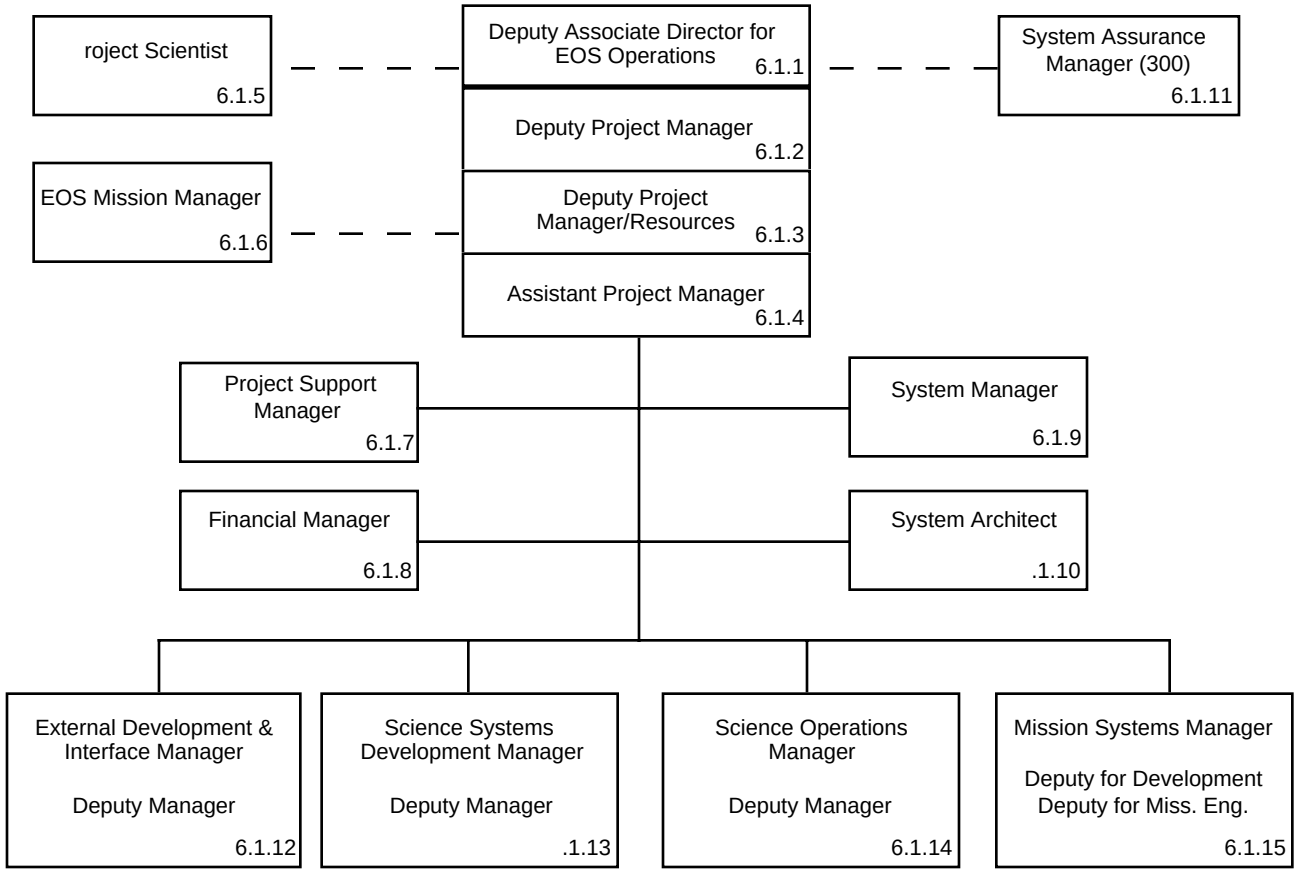


**Figure 6-1. ESDIS Project Organization Chart**

### 6.1.2 Deputy Project Manager (DPM)

The DPM is responsible to the Project Manager. The incumbent supports the Project Manager in directing all phases of the Project and has Project-wide responsibility for personnel management and planning and for evaluating all Project activities on a day-to-day basis. The DPM provides technical management to the team of technically skilled specialists and their supporting personnel to meet cost, schedule, and technical commitments. In the absence of the Project Manager, the DPM assumes full responsibility for the Project.

### 6.1.3 Deputy Project Manager/Resources (DPM/R)

The DPM/R is responsible to the Project Manager. The DPM/R contributes business management expertise to the establishment of technical program objectives and is responsible for the application of business, financial management, and performance measurement techniques to the accomplishment of those objectives. The DPM/R supervises a team of specialists in the area of finance, budget, performance measurement, scheduling, pricing, and configuration management. In addition, the DPM/R provides requirements to the respective Project Procurement Manager on Project-related matters. In the absence of the Project Manager and the DPM, the DPM/R may act for the Project Manager.

### 6.1.4 Assistant Project Manager (APM)

The Assistant Project Manager is responsible to the Project Manager. The APM assists the Project Manager in all areas of the Project as needed and assigned by the Project Manager, with support from the Project staff for specific detailed activities. Specifically, the APM manages advanced planning activities of the Project to ensure that the requirements are defined, impacts of new or changing requirements are understood and costed, agreements with external organizations are developed, and implementation is initiated within the appropriate organization in the Project. Some examples of the advanced planning activities are: enabling and developing working agreements for PI processing; establishing contacts and developing agreements to support new missions/instruments; reviewing Instrument Team's computational resource requirements; and planning for migration of EOSDIS-held data to long-term archives in other agencies.

### 6.1.5 Project Scientist

The Project Scientist, from the Earth Sciences Directorate at GSFC, is responsible for

ensuring the satisfactory accomplishment of the scientific objectives of EOSDIS. The incumbent reviews the requirements, planning, and implementation of the Project to ensure consistency with the overall scientific objectives of the Earth Sciences Program. The incumbent provides leadership in ensuring that the scientific data are used expeditiously, including the allocation of resources for processing, reprocessing, and storage of scientific data from the EOS missions. The Project Scientist is the primary liaison between the scientific community and the ESDIS Project and provides appropriate inputs to the ESDIS Project Manager.

### 6.1.6 EOS Mission Manager

The EOS Mission Manager, from the EOS-G Program Office, is responsible for ensuring that the AM-1 spacecraft and ground system are properly integrated; managing the requirements changes for the AM-1 mission; and conducting operations of the AM–1 mission through on-orbit verification.

### 6.1.7 Project Support Manager

The Project Support Manager is a member of the business support team reporting to the DPM/R. The incumbent is responsible for scheduling, configuration management, logistics management, workforce analysis, property management and control, and other general administrative and overall Project planning activities.

### 6.1.8 Financial Manager

The Project Financial Manager is a member of the business support team and reports to the DPM/R. The incumbent is responsible for the application of sound financial management principles in the areas of cost control, performance measurement, financial analysis, budget preparation and execution, and pricing.

### 6.1.9 System Manager

The System Manager serves as lead engineer for overall integration of the EOSDIS system. He/she oversees implementation of ESDIS support for flight projects, assures that all requirements are met, serves as overall integration manager, resolves inter-element issues and participates in flight project and flight project-related reviews. He/she is responsible for managing the level 2 requirements and inter-element ICDs for the ESDIS Project and will formalize all new mission commitments. He/she will support the DPM: for CM policies and procedures; for CCB issue resolution; for the conduct of Program-level reviews; for risk management; and in coordinating schedule and cost reviews. The System Manager will also lead special studies for the PM.

He/she works with the PM and DPM to assure that the project meets NPD 7120.5A guidelines.

### 6.1.10 System Architect

The System Architect is the liaison between the ESDIS Project and Goddard's Technology process. As areas of risk to the Project are identified, the System Architect will work with the Earth Science Technology Office and other GSFC Technology Managers to establish technology initiatives to help mitigate the risk to the Project. In addition, he/she will take the lead in the development of new concepts.

### 6.1.11 Systems Assurance Manager (Code 300)

The Systems Assurance Manager (SAM) is responsible for establishing, managing, directing, and coordinating the Project Assurance Program to ensure that ground equipment hardware and software meet their intended objectives during development, installation, and operation. In addition, the SAM will chair the ESDIS Project NCR/CAs.

### 6.1.12 External Development and Interface Office (EDIO)

The External Development and Interface Office is responsible for managing the development of non-ECS coupled components; managing the development of the PI processing systems; providing an interface to external groups; developing standards to use and to influence industry; acting as the liaison to the New Data Information System and Services (DISS) Study; participating in the Data Working Group and the Data Panel; managing instrument product development; and working IRDs, ICDs, and Working Agreements among ESDIS, the DAACs, and the Instrument Teams.

#### 6.1.12.1 External Development and Interface Office Manager

In addition to managing the day to day operations of the Office, the EDIO Manager acts as the ESDIS representative to the Data Panel.

#### 6.1.12.2 External Development and Interface Office Deputy Manager (EDIO DM)

The EDIO Deputy Manager is responsible to the Office Manager and supports the Office Manager in directing all activities of the Office. Specifically, the EDIO DM is responsible for managing the budget and schedule for external development. In the absence of the Office Manager, the DM assumes the full responsibility of the Manager.

### 6.1.13 Science Systems Development Office (SSDO)

The SSDO has the responsibility to manage the Science System Components of the ECS contract, including both development and testing of the contractor's products. In addition, the Office has the responsibility for managing the non-ECS implementation efforts that are tightly coupled with the ECS. The SSDO has the lead responsibility for defining the interfaces to the ECS and for end to end testing of the ECS. And finally, the SSDO is responsible for managing and maintaining the V0 system.

#### 6.1.13.1 Science Systems Development Office Manager

The Science Systems Development Office Manager is responsible for managing the day to day activities of the Office. In addition, he/she will chair the Level 3 Science Board; provide status reports to the Project Manager and to GSFC and NASA management; manage the budget and schedule for the Office; support all Project Level reviews; manage the capabilities to be provided in each of the Releases; and manage the prioritization of the development and problem resolution activities.

#### 6.1.13.2 Science Systems Development Office Deputy Manager (SSDO DM)

The SSDO Deputy Manager is responsible to the Office Manager and supports the Office Manager in directing all activities of the Office. In the absence of the Office Manger, the SSDO DM assumes the full responsibility of the Manager.

### 6.1.14 Science Operations Office (SOO)

The Science Operations Office is responsible for timely Data Processing and ECS Communications and Management and Data Archival and Distribution Operations including EOSDIS Version 0 and the DAACs. In addition, the SOO provides the Project's user satisfaction, system utilization and (performance metrics, and science operations and data plans.)

#### 6.1.14.1 Science Operations Office Manager

The Science Systems Development Office Manager is responsible for managing the day-to-day activities of the Office. He/she will manage the budget and schedule for the DAACs and Science Operations and will chair the ECS CCB once system development is completed. He/she will be responsible to the Project Manager, the EOS Program Manager and NASA Headquarters for reviewing and reporting the status of the DAACs and other science operations activities.

#### 6.1.14.2 Science Operations Office Deputy Manager

The SOO Deputy Manager is responsible to the Office Manager and supports the Office Manager in directing all activities of the Office. In the absence of the Office Manger, the DM assumes the full responsibility of the Manager.

### 6.1.15 Mission Systems Office (MSO)

The Mission Systems Office is responsible for managing the development, testing, and operations of those EOSDIS Ground System elements associated with supporting spacecraft operations. Those elements include EMOS, EDOS, Networks, FDS, and EPGS.

#### 6.1.15.1 Mission Systems Office Manager

The Mission Systems Office Manager is responsible for managing the day-to-day activities of the Office. In addition, he/she will chair the Level 3 Mission Board; provide status reports to the Project Manager and to GSFC and NASA management; manage the budget and schedule for the Office; support all Project Level reviews; manage the capabilities to be provided in each of the Releases; and manage the prioritization of the development and problem resolution activities.

#### 6.1.15.2 Mission Systems Office Deputy for Development

The MSO Deputy for Development is responsible to the Office Manager and supports the Office Manager in directing all activities of the Office. The Deputy is also responsible for all activities associated with the development of those elements for which the Office is responsible. In the absence of the Office Manger, the Deputy for Development assumes the full responsibility of the Manager.

#### 6.1.15.3 Mission Systems Office Deputy for Mission Engineering

The MSO Deputy for Mission Engineering is responsible to the Office Manager and supports the Office Manager in directing all activities of the Office. The Deputy is also responsible for all activities associated with mission engineering of those elements for which the Office is responsible.

## 6.2 Special Boards and Committees

### 6.2.1 Mission Specific

Two working groups, the Flight Operations Working Group (FOWG) and the Instrument

Operations Working Group (IOWG), are formed for each flight mission. There will be FOWGs and IOWGs for the AM, PM, Chem, and ICESat missions.

#### 6.2.1.1 Flight Operations Working Group (FOWG)

The FOWG is a forum to assess operational readiness with emphasis on launch preparation. The personnel involved include the Flight Operations Team, Instrument Planning Group, Network Control Center, Flight Dynamics Engineers, Mission Systems Managers and developers, and Flight Software developers. The intent is to develop strategies for achieving launch and activation.

#### 6.2.1.2 Instrument Operations Working Group (IOWG)

The IOWG is similar in nature to the FOWG but focuses on issues and status of the instruments. Membership comes from the Instrument Teams and the Flight Operations Team. Other members are invited on an as needed basis. The IOWG primarily addresses concerns regarding events leading up to launch and instrument activation.

### 6.2.2 Non-mission Specific

Participation in other groups is not on a flight-specific basis but on an ESDIS Project basis. Those groups are discussed below.

#### 6.2.2.1 Committee on Earth Observation Satellites (CEOS)

The CEOS serves as the focal point for international coordination of space-related, Earth observation activities. Members are those national and international government agencies with funding and program responsibilities for a satellite Earth observation program currently operating or in the later stages of system development. CEOS members include NOAA, NASA, the European Space Agency, EUMETSAT, and counterpart space and Earth observation agencies in Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Sweden, Russia, Ukraine, and the United Kingdom. Current observers are agencies from Belgium, Canada, European Community, New Zealand, and Norway.

#### 6.2.2.2 Open GIS Consortium (OGC)

OpenGIS is defined as transparent access to heterogeneous geodata and geoprocessing resources in a networked environment. The goal of the OpenGIS Project is to provide a comprehensive suite of open interface specifications that enable developers to write interoperating components that provide these capabilities. The OGC is organized as a tax-exempt membership corporation whose mission is to

promote the development and use of advanced open systems standards and techniques in the area of geoprocessing and related information technologies. OGC is supported by Consortium membership fees and, to a lesser extent, development partnerships and publicly funded cooperative programs. Numerous academia, commercial corporations (e.g., Intergraph, Oracle), and government organization (e.g., NASA, NIMA, FGDC) belong to OGC. Currently OGC has over 60 member organizations.

#### 6.2.2.3 Technical Committee on Geographic Systems (ISO TC 211)

The ISO Technical Committee 211 is developing ISO 15046. ISO 15046 aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to Earth. The ESDIS Project both contributes to TC 211 and benefits from the resulting standards. The ESDIS Project is contributing actively to the development of the following 15046 standards: Metadata, Services, and Imagery and Gridded Data.

#### 6.2.2.4 Z39.50 Implementor's Group (ZIG)

The Z39.50 Implementor's Group (ZIG) develops, maintains, and provides a forum for discussion about the implementation and use of the Z39.50 protocol: "Information Retrieval (Z39.50): Application Service Definition and Protocol Specification," known both as ANSI/NISO Z39.50 and ISO 23950. The ESDIS Project participates in the ZIG because Z39.50 is the basis of the CEOS Catalog Interoperability Protocol (CIP).

#### 6.2.2.5 IEEE Storage Systems Standards Working Group (SSSWG)

The IEEE Computer Society established Project 1244 for development of Storage System Standards. An associated committee was also formed on the Computer Society's Standards Activity Board. That committee sponsors one working group: the Storage System Standards WG (SSSWG).

The IEEE SSSWG works to model generic mass storage systems and, based on such a model, to develop widely accepted standards, which are readily implemented. It is the intent of the SSSWG to develop standards that are timely, result in interoperable systems, allow system implementation with minimal licensing requirement, result in a ubiquity of systems based on standards, promote use of the best current technologies, result in easy access of information throughout distributed, heterogeneous networks of systems, and permit a full range of scalability of storage systems from the low end to the high end in system sizes.

The IEEE SSSWG is presently completing work on eleven standards for the core portion of its Media Management System. These are:

- 1244.1: Media Management System Architecture,
- 1244.2: Session Initialization Protocol,
- 1244.3: Media Management Protocol,
- 1244.4: Drive Management Protocol,
- 1244.5: Library Management Protocol,
- 1244.6: Media Manager Interchange Protocol,
- 1244.7: Media Manager Control Interface,
- 1244.8: C Language Procedural Interface,
- 1244.9: MMS User Mount Commands,
- 1244.10: MMS Standard Administrative and Operational Commands, and
- 1244.11: Mover.

#### 6.2.2.6 ANSI/AIIM C21 Data Storage Subsystems Committee

The Association for Information and Image Management International (AIIM) sponsors the Advanced Data Storage Subsystems Committee (C21), which develops standards under a number of sub-committees including:

- C21.1: File Storage Management Systems - which develops metadata standards for interchange of files that are stored on sequential media by a File Storage Management System,
- C21.3: Optical Tape - which develops standards that specify the physical and optical characteristics of 12.7 mm optical tape cartridges, and
- C21.4: MEMRI - which develops standards that specify media error monitoring and reporting information to verify stored data on tape media and the means of transporting media error information in a technology and interface independent manner.
- The ESDIS Project actively contributes to C21 standards activities.

## 6.3 Management Support Systems

### 6.3.1 Monthly Status Review

The ESDIS Project holds monthly reviews of the Project's progress. See section 20.2.2 for more details on the MSR.

### 6.3.2 Earned Value System

An Earned Value Management System provides a tool for Project Management to effectively monitor performance of large dollar-value and complex contracts. It provides a way to quantify the cost of the work planned, the value of the work accomplished (Earned Value), and the actual cost of a contract. The establishment of a time-phased performance measurement baseline provides the integration of cost, schedule, and technical scope and basis for quantifying schedule status in dollar terms. The Earned Value Variance Analysis of the data from the system helps the Project to identify unfavorable trends in schedule, cost and technical performance. It also enables the Project to develop forecast of potential over-run or under-run.

The Project has two major contracts that are managed with the Earned Value (formerly Performance Measurement) Management System: The ECS Contract with Raytheon and the EDOS Contract with TRW, Inc. The ESDIS Project uses Micro-frame Program Manager to perform Earned Value Analysis for monitoring these two contracts' cost and schedule performance.

### 6.3.3 Critical Path Analysis

See section 7.1 for the details on Critical Path Analysis.

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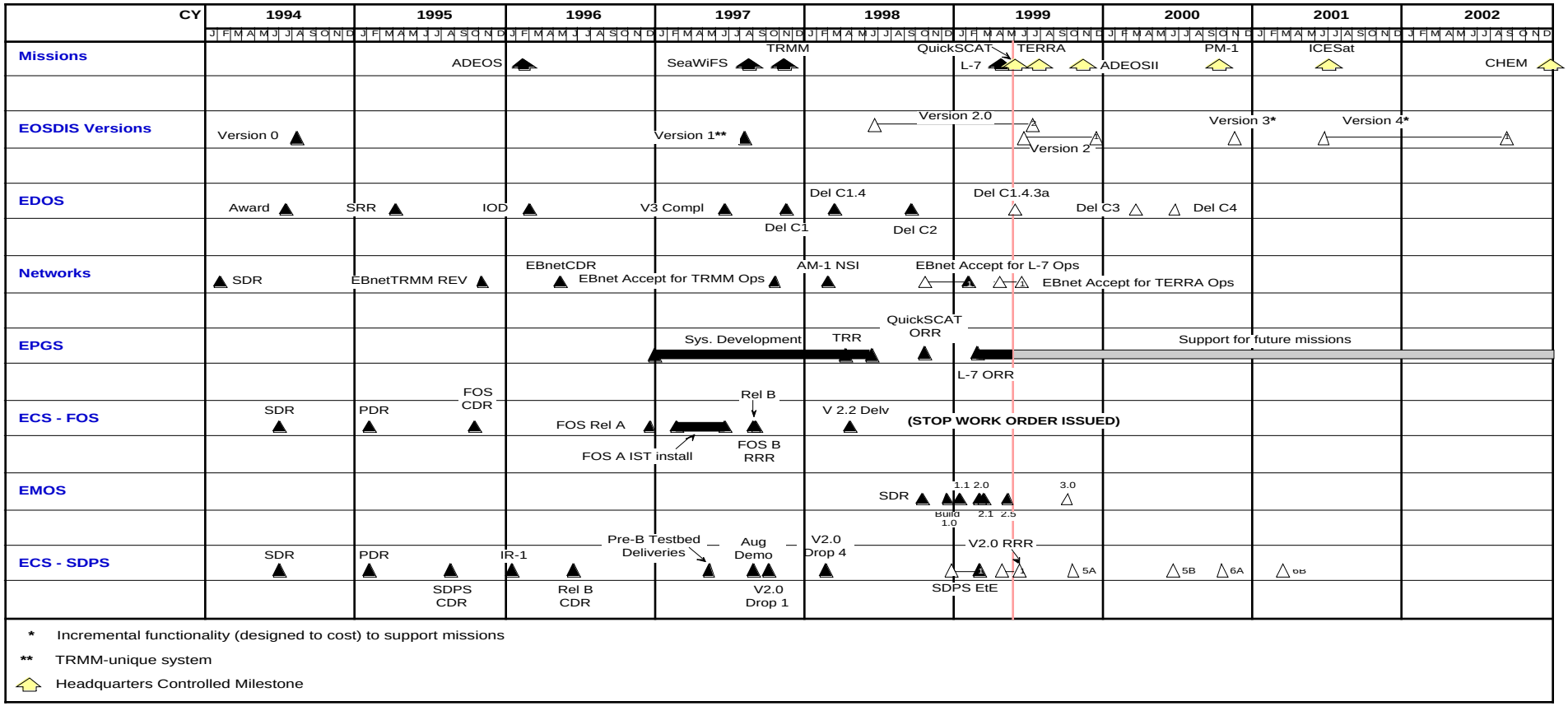
# 7. SCHEDULES

The ESDIS Project maintains a master schedule of the Project's life cycle. Refer to Figure 7-1. ESDIS Project Life Cycle Master Schedule. Lower-level schedules for science systems and mission systems are also maintained.

See the ESDIS Web pages, starting at http://spsosun.gsfc.nasa.gov/new-esdis/Whatis.html> for brief descriptions of the contents of the various EOSDIS versions.

# Earth Science Data & Information System Project
# Code 423




Status as of **5/24/1999**

**Figure 7-1. ESDIS Project Life Cycle Master Schedule**

# 8. RESOURCES

## 8.1 Funding Requirements

The funding requirements for the ESDIS Project are contained in the Program Operating Plan (POP).

## 8.2 Institutional Requirements

The ESDIS Project's institutional manpower requirements are contained in the Manpower Tracking System (MTS). Manpower requirements are derived from GSFC's Statement of Work process.

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# 9. CONTROLS

## 9.1 Change/Configuration Management

The ESDIS Project receives its Level 1 requirements from the EOS-G Program Office, Code 420. The ESDIS Project develops and manages Level 2 requirements. Any new Level 2 requirements or changes to existing Level 2 requirements which impact the Level 1 requirements will cause the ESDIS Project to initiate a Level 1 change request to the EOS-G Program Office. This Level 1 change request must be approved before the Level 2 change can be approved. Impacts will include impacts to cost guidelines, Level 1 schedule commitments, functional and performance requirements, or required contract modifications.

The Project flows down the Level 2 requirements into two sets of Level 3 requirements: Mission Systems and Science Systems. The Project Control Management Boards (PCMBs) flow these requirements down to the Level 4 requirements, that are managed by the implementation contractors. In addition, the DAACs requirements are only in Level 2 Volume 3 but are refined by annual work plans submitted by the DAACs to the ESDIS Project. The SIPS requirements are handled through Working Agreements, IRDs, and ICDs with each of the instrument teams. Any of these documents could imply changes to Level 1 and/or Level 2 requirements documents to reflect changes in the way of doing business.

## 9.2 Key Program Parameters

The key program parameters used to control the program are cost and schedule. The Project holds monthly status reviews where the cost and schedule for each element are reviewed against the baseline.

### 9.2.1 Cost Control

Any element with a variance of more than 5% in cost will be subject to a more intensive evaluation by the Project Manager. If the projected cost growth will have any impact on the Project's cost guidelines, the EOS-G Program Office will be notified.

### 9.2.2 Schedule Control

Schedule performance will be evaluated against the critical path, and elements that have the potential to impact the critical path will also be subject to a more intensive evaluation by the Project Manager. The element will be required to develop a

schedule recovery plan that details how the schedule delay will be managed. If the project schedule slip will have any impact on Level 1 schedules, the EOS-G Program Office will be notified.

### 9.3 Verification of Requirements - Certification

The System Assurance Manager (SAM) prepares the QA Plans and Procedures and submits them to the ESDIS Project Manager for approval. The SAM then assures compliance to the requirements and verifies that the acceptance test complies to the test plan. The SAM also validates the delivery of the hardware and software.

# 10. IMPLEMENTATION APPROACH

## 10.1 Implementation Approach

The ESDIS Project utilizes a development cycle normal to NASA large-system development activities and produces large operational deliveries ("versions") that are formally released to users. The "operational" cycle is driven by the need to implement operational systems available in time to support critical EOS needs (e.g., spacecraft launch). It accommodates change over a long time scale as a phased incorporation of proven technologies and accepted user-sensitive designs into an increasing operational capability. This process provides formal documentation during the development of each operational release. This provides the development rigor and documentation needed by the IV&V and system maintenance activities.

The operational versions of EOSDIS will consist of capabilities needed at various stages to meet the requirements established through the mission baseline. These capabilities are provided by integrating the appropriate releases (or versions) of ECS, EDOS, EBnet, external Networks (NSI), Science Software, and DAAC-unique capabilities. V0 will maintain on-going operations and user services. While it will add some functionality and capacity to capabilities currently available at the DAACs, V0 emphasized user-sensitive areas and the technology needed to support this emphasis. The most important accomplishment of V0 is that it linked the DAACs together and provides interoperability among them to give users an "Earth science view" across the DAACs for searching and ordering data. Future versions provide improved functionality, increased capacity, and incorporate new technology necessary to support EOS AM-1 and other ESE missions.

The following sections summarize the development approach for each of the components of EOSDIS.

### 10.1.1 Version 0

The development of the V0 system was started in FY 1991 with a requirement for delivery in July 1994. The development was carried out according to an overall V0 Implementation Plan. Science advice to V0 was obtained through DAAC Program and Project Scientists, DAAC User Working Groups and Advisory Panels, V0 members of the EOSDIS Panel, and the ESDIS Project Scientist. These scientific groups participated in establishing prioritized system requirements, identifying and prioritizing data sets to be supported by V0 at different levels of service, evaluating the various

components of the system as they are developed, and recommending improvements. A systems engineering review team, chaired by the V0 System Development Manager and composed of members from the ESDIS Project and each of the DAACs, oversaw the technical decisions in V0. A management advisory council, chaired by the DAAC Systems Manager and consisting of the DAAC Managers provided a system-wide view of management and operations decisions; a user services working group composed of members from each DAAC provided guidance, procedures, and system-wide coordination of user services.

### 10.1.2 EOSDIS Core System (ECS)

The ECS is being developed through a major system development and operations contract. The procurement for this contract was started using the results of two Phase-B studies conducted by the Hughes Applied Information Systems, Inc. (HAIS) and Thompson Ramo-Woolridge (TRW) during January 1989 through April 1990. The request for proposals was developed by synthesizing the results of these studies and reflecting the latest Project requirements. As the result of a competitive procurement process, the execution phase was started with the award to HAIS of a 10-year CPAF contract in March 1993. Hughes has since been acquired by Raytheon Systems Company, which continues to perform under this contract. The 10-year period includes several years of maintenance and operation (M&O) support and on-going development after the delivery of the launch-ready system for the EOS AM flight.

The development of ECS will result in a series of incremental releases/drops. The capabilities of each of the releases/drops are defined in the Statement of Work for the ECS contract. These capabilities will match the requirements and the time-phasing of the Versions of EOSDIS. The development of ECS has proceeded in parallel with that of V0. The development of V0 has been an open process with the results and documentation available to the ECS contractor. The ECS contractor has participated in all relevant meetings related to the development of V0.

### 10.1.3 Distributed Active Archive Centers

The DAACs have supported V0 development and continue to operate it serving a large and growing user community. The development and operations of V0 are handled through annual proposals by the DAACs consistent with the EOSDIS DAAC Strategic Management Plan (November 1997). The ECS hardware and software are installed at the DAACs, and the DAACs participate in the integration and test activities. The DAACs can propose to perform unique prototyping activities relevant to their specific environment and to develop unique capabilities to augment the delivered

ECS functionality. The activities at the DAACs are managed through Implementation Agreements or contracts, as appropriate, depending on the type of organization.

### 10.1.4 Science Investigator-Led Processing Systems (SIPS)

In a recently developed new paradigm for collaborating with PIs/TLs, the ESDIS Project has defined an Adaptive Approach to production of EOS standard data products. With this approach, the ESDIS Project defines requirements for the production systems and their interfaces with the other EOSDIS components. The PIs/TLs submit proposals, which are evaluated for cost and benefit. If the proposal is approved, the processing is performed at their Science Investigator-led Processing System (SIPS). The PIs/TLs may propose to produce some or all of their standard data products. The SIPS are generally, but not necessarily, collocated with the PI's/TL's Science Computing Facilities. The products generated at the SIPS are delivered to the appropriate DAAC for archiving and distribution to users. The PIs/TLs are funded for this work through appropriate Working Agreements.

### 10.1.5 EOS Data and Operations Systems

The requirements for EDOS were developed based on those for the Customer Data and Operations System (CDOS), which was originally to be provided by NASA as an institutional system for all flight missions. Two Phase-B studies were conducted by Martin-Marietta Corporation and TRW for CDOS/NASA Communication Network (NASCOM)-II (NASCOM-II was the institutional system that was planned to provide communications capabilities for all flight missions). Following the issuance of a directive by the Deputy Administrator of NASA making the EOS Program responsible for funding and managing the data operations and communications capabilities needed for it, the requirements were analyzed and reduced appropriately to meet the EOS needs. The EDOS has been developed through a CPAF contract competitively awarded in September 1994 to TRW. Network services for EOS are being provided by NISN (see section 10.1.7).

### 10.1.6 FOS/EMOS

The ECS contractor has the responsibility to develop and deliver a Flight Operations Segment (FOS) to support the on-orbit operations of the EOS spacecraft and associated instruments.

The instantiation of FOS in support of AM-1 has been named the EOS Mission Operations System (EMOS). The EMOS is based on planning and scheduling (Department of Defense heritage) and real-time command and control (commercial

sector heritage) components supplied by Raytheon and analysis (NASA heritage) command management and data management components.

### 10.1.7 Networks

#### 10.1.7.1 EOSDIS Backbone Network (EBnet)

Mission Network requirements are implemented by the NASA Integrated Services Network (NISN) Project for the ESDIS Project. Mission critical requirements are implemented as the EOSDIS Backbone Network (EBnet). EBnet includes a class of near real-time and high-reliability routed IP protocol and clock and data services that provide wide-area communications among various EOS Ground System (EGS) elements to support mission operations and to transport spacecraft command, control, and science data nationwide on a continuing basis. Real-time data includes mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. Science data includes information collected from spacecraft instruments and various levels of processed science data, including expedited data sets, production data sets, and rate-buffered science data.

EBnet serves as the interface to other EGS elements, such as Distributed Active Archive Centers (DAACs), mission critical instrument teams, and the NASA Internet. EBnet also includes campus interfaces that provide communications among the Wide Area Network (WAN), NISN, and EOSDIS Local Area Networks (LAN).

Technical support for implementation of EBnet is provided by Code 290 for the ESDIS Project. Code 290 acts in a dual role with NISN, as a supporting organization for NISN and for the ESDIS Project.

#### 10.1.7.2 NASA Internet (NI)

The NI networks are provided by NISN to implement network services between EOSDIS external wide area networks (the Internet) and the EOSDIS Core System (ECS). NI will be used to make data available from ECS facilities to EOSDIS users, including EOS Project funded investigators and non-EOS affiliated scientists and researchers.

#### 10.1.7.3 NASA Integrated Services Network (NISN) Project

The NISN Project is chartered to provide a consolidated set of NASA wide area

network services for the transmission of data, video, and voice. The NISN is managed by NASA's Marshall Space Flight Center in Huntsville, Alabama. All EOSDIS network requirements are implemented through the NISN.

NISN responsibilities for the NI and EBnet include:

a. Engineering the network implementation (e.g., backbone, tail circuits, internal routers, etc.)
b. Scheduling installation of new network services and backbone upgrades based on customer (ESDIS and others) requirements
c. Network performance monitoring
d. Network capacity planning
e. Network fault isolation and error detection, isolation, and fault resolution in coordination with EOSDIS.

### 10.1.8 EOSDIS Test System

The EOSDIS Test System is being developed by GSFC to provide test data to support all phases of EOS ground system testing. The ETS will be used to support mission readiness activities and to verify the performance of ground data systems supporting the EOS missions. The ETS can be used to test EOS elements involved in data processing (up to and including Level 0 processing) and data transport.

The ETS will be used to generate test data according to specifications provided by the EOS test team and will transmit the prepared test data at the requested data rate to the element under test. Data received by ETS during a test session will be captured and analyzed, with ETS providing quality and performance monitoring capabilities.

### 10.1.9 Independent Verification and Validation (IV&V)

The IV&V is an activity supporting the ESDIS Project in assuring independent checking of the efforts conducted by the developers of the components of EOSDIS. Verification is the interactive process of determining whether or not the products of a given phase of a system development cycle fulfill the requirements established during the previous phase. Validation is the process of evaluating the as-built system at the end of its development process to ensure compliance with system requirements.

The ESDIS Project is conducting IV&V through a competitively awarded contract to

permit independent checking of the developments by the ECS and EDOS contractors and the EBnet in-house team and conduct/verify/certify key interfaces and end-to-end testing of the EOS Ground System. The IV&V effort will provide an objective means to ensure that:

- Errors are detected and corrected as early as possible in the system life cycle
- Risks, cost, and adverse schedule impacts are lessened
- System quality and integrity are enhanced
- Visibility of the system development and evaluation process is enhanced

### 10.1.10 System Integration and Test (SI&T) Approach

The ESDIS Project's System Integration and Test (SI&T) approach consists of a series of phased, incremental integration and test activities that culminate in a formal end-to-end test data flow that demonstrates the EOS Ground System (EGS) readiness for launch and mission operations support. The features of this phased approach include:

- subsystem and component integration and tests performed within the appropriate development organization,
- independent subsystem/component test either within the appropriate development organization or by designated independent organization,
- series of string tests across system elements resulting in an early interface verification,
- multiple releases of increasingly functional strings across the system enabling early functional verification,
- operational data flows and mission simulations to certify system readiness to support mission operations, and
- independent verification and validation of the EOS Ground System (EGS)

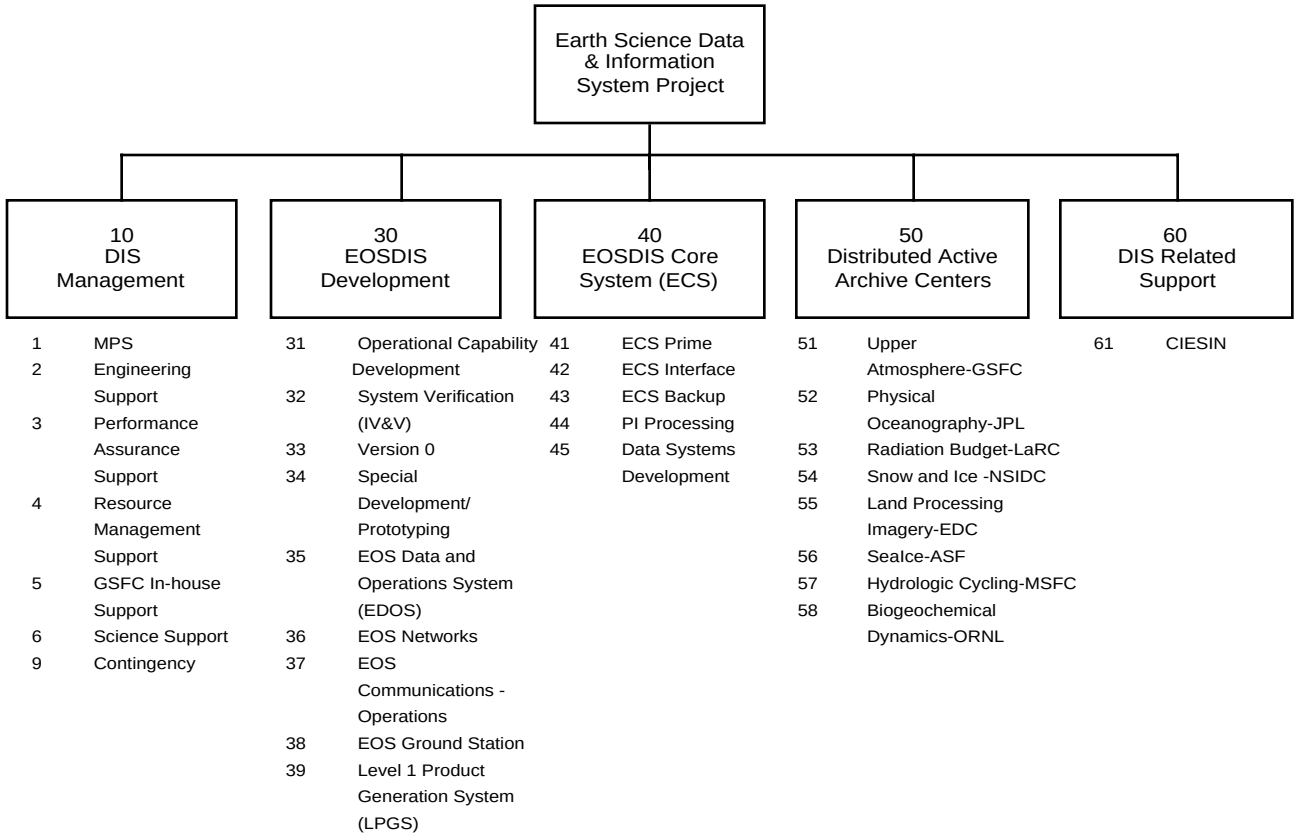
Management of the System Integration and Test approach is a joint venture of ESDIS Project managers.

**Table 10-1. EOSDIS Ground System Testing Summary**

| Test Phase Description | Lead ESDIS Responsibility | Lead Contractor Organizations |
|---|---|---|
| Component testing | Subsystem Development Managers | Subsystem Developer |
| Developer Independent Acceptance Testing | Subsystem Development Managers | Independent Test Organization |
| Progressive String Tests | ESDIS I&T Managers | ESDIS Support Contractor |
| Key Interface Tests | ESDIS I&T Managers | ESDIS Support Contractor |
| Data Flows and Mission Simulations | ESDIS Ops Managers | M&O Teams |
| Independent Verification & Validation | ESDIS I&T Manager<br>ESDIS Ops Manager<br>DAAC Ops Managers | ESDIS IV&V Support Contractor |

## 10.2 Project Summary Work Breakdown Structure (WBS)

The Project Summary Work Breakdown Structure is shown in Figure 10-1.




*WBS Elements 20 (SCFs) and 70 (Science Computing Facilities) are no longer in use.

**Figure 10-1. ESDIS WBS**

# 11. ACQUISITION SUMMARY

Table 11-1 identifies all major procurements for the ESDIS Project. A description of the work, the type of procurement, the contract type, the contract number, and the contractor are identified.

**Table 11-1. Summary of Direct Contract Support to the ESDIS Project**

| Contractor | Contract Number | Contract Type | Type of Procurement | Description of Work |
|---|---|---|---|---|
| Raytheon | NAS5-60000 | CPAF | Competitive | Development and initial operation of the EOSDIS Core System (ECS) |
| Intermetrics | NAS5-32605 | CPAF | Competitive | Independent Verification and Validation (IV&V) of the EOSDIS and key EOS Ground System interfaces |
| TRW, Inc. | NAS5-32660 | CPAF | Competitive | Implementation, initial operation, and upgrading of the Earth Observing System (EOS) Data and Operations System (EDOS). |
| DoE | S19614-F | Interagency Agreement | Non-Competitive | Oak Ridge DAAC Support |
| University of Alaska | NAS5-98129 | Cost Reimbursable | Non-Competitive | Alaska SAR Facility Support |
| USGS | S56372-E | Interagency Agreement | Non-Competitive | EROS Data Center Support |
| University of Colorado | NAS5-98070 | Cost Reimbursable | Non-Competitive | NSIDC DAAC Support |
| Columbia Univ. | NAS5-98162 | Cost Reimbursable | Non-Competitive | Operation and Maintenance of the Earth Observing Socioeconomic Data and Applications Center |

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# 12. PROGRAM/PROJECT DEPENDENCIES

## 12.1 Parent Programs and Other Relationships

### 12.1.1 Committee on Environmental and Natural Resources

The Committee on Environment and Natural Sciences (CENR) is one of nine committees that make up the President's National Science and Technology Council, which coordinates R&D policy issues across the Federal Government. The role of the CENR is to improve coordination among Federal Agencies involved in environmental and natural resources research and development, establishing a strong link between science and policy and developing a Federal environmental and natural resources research and development strategy that responds to national and international issues. To this end, the CENR has established subcommittees to address separable but related broad areas of research.

### 12.1.2 U.S. Global Change Research Program

One of the CENR subcommittees, the Subcommittee on Global Change Research, has as its special focus the view of the Earth as an integrated system, and the identification of changes, their sources and their impacts. This subcommittee has as its working entity the U. S. Global Change Research Program (USGCRP). The USGCRP provides a framework for U. S. global climate activities in terms of seven science elements: 1) physical climate and hydrological systems; 2) biogeochemical dynamics; 3) ecological systems; 4) Earth system history; 5) human interactions; 6) solid Earth processes; and 7) solar influences. While NASA's Earth Science Enterprise programs, and the Earth Observing System (EOS) program in particular, provide data and analyses of use to all CENR subcommittees and beyond, they most directly benefit the areas of research of the USGCRP. More information on the USGCRP can be found at <http://www.usgcrp.gov/>.

### 12.1.3 Earth Science Enterprise

The mission of NASA's Earth Science Enterprise (ESE) is to develop an understanding of the total Earth system and the effects of naturally and human-induced changes on the global environment. Its research efforts are primarily focused on space-based studies of the Earth as an integrated system. Its contribution to the USGCRP represents the largest participation in the program by any single agency and includes a series of flight projects, a basic research program, and a comprehensive

data and information system, EOSDIS. Additional information on the Earth Science Enterprise can be found at <http://www.earth.nasa.gov/>.

### 12.1.4 International Relationships

#### 12.1.4.1 International Partners

International partners, including Japan, Europe and Canada, will provide data to be incorporated into NASA's studies of the Earth as an integrated system. Bilateral agreements between NASA HQ and the foreign agencies will govern the exchange of information, data, and software. ESDIS supports NASA HQ in both the generation and execution of the agreements.

#### 12.1.4.2 International Science Community

Many U.S. scientists collaborate with their foreign counterparts in their global change research programs following plans developed under the World Climate Research Program (WCRP). This planning has been led, in many instances, by joint activities of the International Council of Scientific Unions (ICSU) and the World Meteorological Organization (WMO). In addition, the ICSU has established a Scientific Committee for the International Geosphere-Biosphere Program (IGBP). While any new requirements generated by the International Science Community must go to the Associate Administrator for the Earth Science Enterprise, EOSDIS data and operational services can play a significant role in supporting these international research programs.

#### 12.1.4.3 Committee on Earth Observation Satellites (CEOS)

CEOS was created in 1984 as a result of the International Economic Summit of Industrialized Nations and serves as the focal point for international coordination of space-related, Earth observation activities. The CEOS Working Group on Information Systems and Services (WGISS) facilitates the use of data from Earth observation missions by coordinating and standardizing data management processes. More information on WGISS can be found at <http://wgiss.ceos.org>.

The ESDIS Project has had a long history of participation in the Access, Data, and Networks Subgroups of WGISS. The WGISS goal of enabling Earth observation data and information services to be more accessible and usable to data providers and data users world-wide through international coordination is consistent with and complementary to the objectives of EOSDIS. The subgroup prototyping and standards activities allow ESDIS to present their system concepts and standards to an

international forum and to learn from the experiences of the other CEOS participating agencies.

## 12.2 EOS Program Components

The EOS Program consists of four primary components:

1. The EOS Scientific Program
2. The EOS Algorithm Activities
3. The EOSDIS
4. The EOS Flight Program

These four components have extensive interrelationships in addition to strong linkages to the Earth science community.

### 12.2.1 EOS Scientific Program

The EOS Scientific Program focuses on defining the state of the Earth system, understanding its basic processes, and developing and applying predictive models of those processes. The science component of EOS consists of both focused-disciplinary research centered around a specific Earth science data set and interdisciplinary research geared toward a broader probe into Earth science systemic functions.

### 12.2.2 EOS Algorithm Activities

The EOS Algorithm activities consist of the development, maintenance, and operation of the algorithms that produce the EOS standard data products, including routine intellectual quality control of these products. As such, these activities serve to unite the flight instruments, science, and the information system. EOS algorithms are supplied to EOSDIS when data are to be processed at the DAACs.

### 12.2.3 EOSDIS

The EOSDIS provides computing and network facilities to support the EOS research activities, including data interpretation and modeling; processing, distribution, and archiving of EOS and other Earth science data; and command and control of the spacecraft and instruments.

### 12.2.4 EOS Flight Program

The EOS spacecraft, designated morning (AM), afternoon (PM), ICE Satellite (ICESat), and Chemistry (CHEM), will be flown as flight series, carrying payloads designed to measure physical phenomena from which specific data products can be derived. The physical phenomena to be measured by each flight series are as follows:

- The EOS-AM flights will be placed in a Sun-synchronous polar orbit with a morning Equatorial descending crossing time (hence the "AM" designation). They will fly a payload complement designed to measure physical phenomena associated with clouds, aerosols, and radiative balance. In addition, the EOS-AM will be capable of providing characterization of the terrestrial surface and ocean productivity.
- The EOS-PM flights will be placed in a Sun-synchronous polar orbit with an afternoon Equatorial ascending crossing time. They will fly a payload complement designed to measure physical phenomena associated with atmospheric temperature and humidity, clouds, precipitation, radiative balance, terrestrial snow and sea ice, sea-surface temperature and ocean productivity, soil moisture, and improvement of numerical weather prediction.
- The ICESat flight will perform altimetry measurements focused on evaluating ice sheet mass.
- The EOS-CHEM flights will perform measurements focused on evaluating atmospheric chemical species and their transformations.

In addition to these EOS spacecraft, there will be EOS-funded Flight of Opportunity (FOO) instruments that will be flown on other U.S. and international spacecraft.

## 12.3 EOS Program Integration

The accomplishment of the EOS Program mission objectives requires a comprehensive integration of the four Program components: Science, EOSDIS, Algorithm Development, and Flight Programs to ensure that the EOS requirements are satisfied in the broader context of NASA's ESE and the USGCRP. For detailed information on how this integration is managed, the reader is referred to the Execution Phase Project Plan for Earth Observing System (EOS).

## 12.4 Space Operations Management Organization (SOMO)

The ESDIS Project negotiates Project Service Level Agreements (PSLAs) with SOMO for services in support of EOS missions. These include space to ground and terrestrial network services; EDOS operations; and mission operations once the ECS contract has ended.

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# 13. AGREEMENTS

Table 13-1 lists the ESDIS Project's agreements that have already been approved.
Table 13-2 lists the ESDIS Project's agreements that are still pending.

## Table 13-1. ESDIS Agreements - Approved

| PARTNER | TYPE OF ACTIVITY (Flight, Ground-based/airborne, Data System, Other) | ACTIVITY | TIME PERIOD OF ACTIVITY | DATE AGREEMENT COMPLETED |
|---|---|---|---|---|
| Australia/CSIRO | D | EOSDIS Interop | Underway | 02/96 |
| Brazil/AEB | F | HSB instrument on EOS PM1 | Launch 2000 | 12/96 |
| Canada/CSA | F | Flight of MOPITT on EOS AM1 | Launch 1999 | 11/94 |
| Canada/CSA | F | Launch of Radarsat-1 and data sharing | Launched in 1996 | 08/95 |
| ESA | G | ESA personnel exchange (ESRIN/Moeller) | 1997-98 | 09/96 |
| France/CNES | F | Jason 1 | Launch 1999 | 12/96 |
| Germany/DLR | O | Interoperability agreement | | 06/97 |
| Japan/NASDA | F | ADEOS-1 MOU | Launched in 1996 | 06/96 |
| Japan/NASDA | F | AMSR Interim Letter Agreement (flight on EOS PM1) | Launch 2000 | 06/96 |
| Japan/NASDA | F | ADEOS II/SeaWinds Interim Agreement | Superseded by ADEOS-II MOU | 09/96 |
| Japan/Miti | F | ASTER MOU (flight on EOS AM1) | Launch 1999 | 11/96 |
| Japan/NASDA | F | ADEOS II MOU | Launch 1999 | 03/97 |
| Japan/NASDA | F | Tropical Rainfall Measuring Mission | Launched in 1997 | 10/95 |
| Netherlands/RSB | D | EOSDIS | 1996-2000 | 09/96 |
| Russia/IRE-RAS | D | EOSDIS Interoperability | Underway | 09/96 |
| Russia/RSA | F | Flight of TOMS & SAGE on Russian METEOR satellites (EOS-AERO) | 1998 | 09/96 |

## Table 13-2. ESDIS Agreements - Pending

| PARTNER | ACTIVITY |
|---|---|
| Australia | CCRS EOSDIS Interoperability |
| Brazil | INPE Networks |
| ESA | EOS-ENVISAT data exchange |
| EU JRC | SeaWiFS |
| Germany | EOS-ENVISAT data exchange |
| Japan | Final AMSR MOU |
| MITI | network cost sharing LOA |
| NASDA | Network sharing LOA |
| Russia | EOSDIS Interoperability (AARI) |

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# 14. PERFORMANCE ASSURANCE

## 14.1 General

The ESDIS Project will follow the GSFC Quality Management System for the development of products and delivery of services.

The Performance Assurance Program for the ESDIS Project is based upon the policy and requirements contained in NASA Standards as well as ISO GPGs and PGs.

The basic elements of the Performance Assurance Program have been translated into requirements that are implemented by each instrument, each spacecraft, and the ground system and are contained in the applicable Performance Assurance Requirements.

The ESDIS Performance Assurance Program addresses hardware and software for both the EOSDIS Core System (ECS) and the EOS Data and Operations System (EDOS).

## 14.2 Quality Assurance

The Quality Assurance Program requirements for ESDIS will follow the quality tasks delineated in Quality Program Provisions for Aeronautical and Space System Contractors, NHB 5300.4 (1B), tailored to the Project and mission requirements by the EOS 420-05 document series (Performance Assurance Requirements).

The Quality Assurance Plan for ESDIS (505-13-01) identifies the assurance activities performed to ensure that the ESDIS Project delivers high-quality products and services conforming to NASA, GSFC, and ESDIS Project standards. Activities include QA audits of products and processes, non-conformance reporting and corrective action, configuration management support, risk management support, management review support, and system safety.

## 14.3 Performance Verification

### 14.3.1 Test and Analysis Program

A formal EOS test and analysis program shall be conducted to provide assurance that

the hardware and software are capable of surviving and performing their mission within specifications under the various environments to which they will be subjected.

For the ground system, the verification activity shall include verification requirements for the hardware and validation of the software (walkthroughs and inspections, as well as tests). In addition, IV&V of the ground system shall be accomplished under a separate contract.

### 14.3.2 End-to-End Compatibility Tests and Simulations

End-to-End tests will be conducted on the entire EOS and shall, as far as practicable, include all portions of the operational system, such as all flight hardware, with appropriate stimulation of instruments; and operational software and ground systems, including the EOC, NISN, EDOS, EOSDIS internal networks, EOSDIS external networks, and ground processing facilities. These tests demonstrate that the system meets the functional requirements and that data flow paths and actual data, in an acceptable form, are verified as required for the mission. Also, mission simulation exercises shall be conducted to validate nominal and contingency mission-operating procedures and to provide for operator familiarization training.

## 14.4 Additional Contractor Reviews

Contractors are defined here as out-of-house instrumenters, industrial contractors and subcontractors, and NASA in-house organizations responsible for providing hardware and/or software. These contractors shall conduct reviews for all designs within the components and subsystems of the ground segment. Summaries of discussions and decisions reached at these reviews shall be provided to the appropriate project element. The affected Project Office reserves the right to participate in these reviews. These reviews are in addition to the NASA reviews described in Section 20.

## 14.5 Maintainability

For project elements where maintenance is a factor in mission success, a maintainability program will be established to ensure that design of the EOSDIS allows for practical and economical maintenance within established program and mission constraints. Emphasis will be placed on identifying trade-offs and decisions relative to hardware upgrades and software modifications. The maintenance plan will identify logistics requirements needed to support its concepts that affect procurement and operation of support/test equipment, training, technical data, and parts.

# 15. RISK MANAGEMENT PLAN

## 15.1 Introduction

Risk management for the ESDIS Project is a sustaining function managed at the Project level with inputs from each of the Offices. Risks are divided into three interdependent areas: cost, performance, and schedule. The risk management process consists of Identification, Analysis, Tracking, and Mitigation of individual risk items. Risk management at the ESDIS Project level is the responsibility of the Deputy Project Manager. Major risk mitigation issues may also be addressed by the ESDIS Project Manager.

## 15.2 Risk Management Approach

The ESDIS Project is an ongoing project that has used a variety of approaches to risk management in the past. At this stage of project maturity, it is desirable to implement a risk management approach that has a minimum burden on the Project but that can cope successfully with long-standing risk issues. Risk management functions according to a classical strategy. Risk elements are first identified and assessed as to their criticality. Risks are tracked continuously and documented. For every risk, a timeline for resolution and one or more mitigation strategies are developed. Cost-, performance-, or schedule-related changes are made at the element level as required to mitigate risk. Whenever a risk is not mitigated according to plan, it is elevated to the attention of the Deputy Project Manager and, when necessary, to the Project Manager for action.

The Deputy Project Manager is responsible for management of overall risk mitigation. The Deputy Manager will ensure that the risks are documented and assess their Project-level impact. The Deputy Project Manager will coordinate inter- or intra-element activities necessary to mitigate risks and has the authority to implement changes that require trades from one element to another without impact to Level 1 requirements. Risks that require action at the Program level will be elevated to the Project Manager for action.

The ESDIS Project Manager has the authority to adjust system-wide constraints or request changes to Level-1 requirements in order to address risks. The Project Manager will ensure that risks with major program impact have awareness at the EOS Program level and will negotiate Project-level mitigation plans and schedules.

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# 16. ENVIRONMENTAL IMPACT

The ESDIS Project will be planned and executed in conformance with:

1. NASA regulations entitled Environmental Quality (14 CFR Part 1216);
2. other relevant Federal environmental laws, regulations, and Executive Orders; and
3. NMI's addressing environmental issues.

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# 17. SAFETY

An ESDIS Project safety program includes the assurance of system safety and the consideration of human factors in system man/machine interfaces.

## 17.1 Industrial Safety

The safety procedures and requirements to be followed in implementing the ESDIS Project are in response to and in accordance with the policies and guidelines set forth in GSFC Health and Safety Program, GMI 1700.2C; Basic Safety Manual, NHB 1700.1 (V1-B); and the overall GSFC policy of avoiding injury to people and property loss to the maximum extent practical.

## 17.2 Contractor's Facilities

Each of the Project's contractors will address their own safety and security in their facilities.

## 17.3 Data Security

The ESDIS Project will interface with the Center Security Office to ensure that its data security efforts are in compliance with NASA and GSFC requirements and standards.

## 17.4 References

Two documents that govern safety for all occupants of Building 32:

- Building 32 Evacuation Plan
- Building 32 Health and Safety Plan

Copies of these plans may be obtained from the Building 32 Facility Operations Manager (FOM).

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# 18. TECHNOLOGY ASSESSMENT

## 18.1 Background

In the ESDIS Project, technology assessment is an iterative process that feeds the ESDIS Project's prototyping efforts. Early on in the Project, those elements having high levels of risk associated with them were identified. Also identified were elements where evolutionary enhancements would be desired. Technology proposals are evaluated against those areas of risk or desired enhancements before they are accepted.

## 18.2 Process

The Project defined a process to handle unsolicited prototyping proposals. Proposal writers are required to associate their proposals with one of the risk or desired evolutionary enhancement elements. A proposal template was developed that proposal writers must use when submitting a proposal for consideration. A review group of four individuals was formed, two "internal" individuals nominated by the System Architect and two "external" individuals nominated by the Data Panel. This group reviews all proposals for applicability and benefit to the Project and can recommend approval, rejection, or modification. In the event the group of four are split in their determination, the Project Manager will make the final decision to accept or reject a proposal.

All accepted proposals are monitored through on-line quarterly status updates and twice-yearly demonstration and progress reviews.

## 18.3 Current Technology Programs

A description of the ESDIS Project's Technology Program may be found on the World Wide Web at <http://proto.gsfc.nasa.gov/esdis/>.

## 18.4 Transition

FY 99 is a transition year. Post FY 99, prototyping funds and Level 2 direction will transition to the Earth Science Technology Office, Code 710. At this time, processes and procedures have not been completed, but it is anticipated that there will be open competition for these funds with EOSDIS as one "customer" and possibly one "competitor."

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# 19. COMMERCIALIZATION

The ESDIS Project's commercialization programs are managed in conjunction with companion programs managed by NASA Headquarters Code Y. These programs include the following:

## 19.1 Stennis Data Buy Program

The NASA Commercial Remote Sensing Office at the Stennis Space Center is managing a program to purchase Earth Science data and related information from commercial sources. The purchased information will be used by research teams within NASA's Earth Science Enterprise. By purchasing data upon delivery from private industry instead of developing, building; and launching new satellites, NASA hopes to be able to conduct and expand its scientific investigations at a much lower cost, while encouraging the growth of a new economic sector.

## 19.2 Commercial Standards

The ESDIS Project is supporting the development of commercial standards that will facilitate the sharing of Earth Science Enterprise data. These include the following:

1. HDF-EOS - the standard format for EOSDIS data products. It is based on the National Center for Supercomputing Applications Hierarchical Data Format (HDF). Several vendors of commercial packages for analysis and visualization of scientific data are supporting HDF and HDF-EOS. This will allow users to easily access and use EOSDIS data;
2. Catalog interoperability - working with joint international, interagency, and GIS vendor community; and,
3. Media interoperability - developing standards to enable low-cost migration of media from one File Storage Management System product to another.

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# 20. REVIEWS

## 20.1 Program Level Reviews

### 20.1.1 Independent Annual Review

The ESDIS Project reports to the NASA Headquarters Associate Administrator, Earth Science Enterprise, once a year. The purpose of this review is to provide a validation of conformance to the PCA. The following items are covered at this review:

- Assessment of the progress/milestone achievements against the original baseline
- Review and evaluation of the cost, schedule, and technical content of the Project over its life cycle
- Assessment of technical progress, risks remaining, and mitigation plans
- Determination of any existing Project deficiencies resulting in revised projections exceeding the predetermined thresholds

## 20.2 Project Level Reviews

### 20.2.1 Management Coordination Review (MCR)

The ESDIS Project conducts a monthly review with the Director of Code 400 and the EOS-G Program Manager. The technical, schedule, and financial status of the ESDIS Project are presented.

### 20.2.2 Monthly Status Review (MSR)

The ESDIS Project holds a monthly review with the GSFC Center Deputy Director. The technical, schedule, and financial status of the ESDIS Project are presented.

### 20.2.3 Project Status Review (PSR)

This review is internal to the ESDIS Project. Each major area of the Project and the Project's primary contractors report to the Project Management Team. Significant events since last month's review; accomplishments; budget, technical, and schedule status; and issues are covered.

## 20.3 Mission Systems Reviews

### 20.3.1 Requirements Reviews

For each EOS flight, it may be necessary to implement flight specific requirements in the ESDIS system. Separate Requirements Reviews will be held for each flight project to ensure that the requirements to be implemented meet the objectives of the flight project; will lead to a reasonable solution; and are consistent with the overall objectives of the EOSDIS.

### 20.3.2 Design Reviews

Again, for each EOS flight, a Design Review will be held to present the high-level design for that flight project, to identify all impacted sub-systems and interfaces; to verify that the proposed design will satisfy the requirements approved in the Requirements Review for that flight project; to determine that a test plan has been developed to verify the performance of the system after implementation of the requirements; and to audit traceability between the requirements and the design.

### 20.3.3 Mission Operations Review (MOR)

Approximately one year prior to each scheduled flight, a Mission Operations Review will be held to verify that the ESDIS Project is preparing the EOSDIS and operations personnel to meet the mission launch and on-orbit operations commitments.

### 20.3.4 Flight Operations Review (FOR)

Approximately 90 days prior to each flight, a Flight Operations Review will be held to determine the system's (flight and ground) readiness to support a safe and successful launch and subsequent flight operations. The ESDIS Project will support this review and will present the results of tests, demonstrations, and analysis that demonstrate the EOSDIS is ready to support the upcoming launch, that all necessary procedures are in place and verified, and that all operations personnel are trained and ready to support the mission.

### 20.3.5 Operational Readiness Review (ORR)

Within approximately 90 days of launch, an Operational Readiness Review will be held to examine the EOSDIS readiness to support the mission. The readiness of all ground hardware, software, personnel, procedures, and user documentation are verified.

## 20.4 Science Systems Reviews

### 20.4.1 Release Readiness Review (RRR)

Prior to the formal acceptance of a release for use, a Release Readiness Review will be conducted to review the results of end-to-end tests performed in the DAACs; summarize the new capabilities and changes added by the release; and verify that all requirements allocated to the release have been met.

### 20.4.2 Test Readiness Review (TRR)

Prior to formal testing of a release, a Test Readiness Review will be conducted to ensure that the test article (hardware and/or software), the test facility, ground support personnel, and test procedures are ready for testing.

### 20.4.3 Operational Readiness Review (ORR)

Prior to installing a new release, an Operational Readiness Review will be held to determine if the release is ready to be put into operations. The readiness of all ground hardware, software, personnel, procedures, and user documentation are verified.

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# APPENDIX A

## Acronyms and Abbreviations

| | |
|---|---|
| ADC | Affiliated Data Center |
| ADEOS | Advanced Earth Observing System (Japanese) |
| AGS | Alaska Ground Station |
| AIIM | Association for Information and Image Management |
| AM | morning (ante meridian) |
| AMSR | Advanced Microwave Scanning Radiometer |
| AMSU | Advanced Microwave Sounding Unit |
| API | Applications Programming Interface |
| APM | Assistant Project Manager |
| ASF | Alaska SAR Facility |
| ASTER | Advanced Spaceborne Thermal Emission and Reflective Radiometer |
| CCB | configuration control board |
| CCSDS | Consultative Committee for Space Data Systems |
| CDOS | Customer Data and Operations System |
| CENR | Committee on the Environment and Natural Resources Research |
| CEOS | Committee on Earth Observation Satellites |
| CFR | Code of Federal Regulations |
| Chem | chemistry |
| CIP | Catalog Interoperability Protocol |
| CPAF | cost plus award fee |
| CSA | Canadian Space Agency |
| DAAC | Distributed Active Archive Center |
| DADS | data archive and distribution system |
| DAF | data archive facility |
| DAS | Data Assimilation System |
| DFA | dual frequency altimeter |
| DISS | Data Information Systems and Services |
| DoE | Department of Energy |
| DM | Deputy Manager |
| DPM | Deputy Project Manager |
| DPM/R | Deputy Project Manager/Resources |
| DPRB | Data Processing Resources Board |
| EBnet | EOSDIS Backbone Network |
| ECS | EOSDIS Core System |

| | |
|---|---|
| EDC | EROS Data Center (DAAC) (USGS) |
| EDIO | External Development and Interface Office |
| EDOS | EOS Data and Operations System |
| EEE | electrical, electronic, and electromechanical |
| EGS | EOS Ground System |
| ELV | expendable launch vehicle |
| EMOS | EOS Mission Operations System |
| EOC | EOS Operations Center |
| EOIS | Earth Observation Information System |
| EOS | Earth Observing System |
| EOS-G | EOS-GSFC (refers to the GSFC Program Office for EOS) |
| EOSDIS | Earth Observing System Data and Information System |
| EOSP | Earth Observing Scanning Polarimeter |
| EPGN | EOS Polar Ground Network |
| EPGS | EOS Polar Ground Stations |
| EPPP | Execution Phase Project Plan |
| ERG | EOSDIS Review Group |
| ERS | Earth Resources Satellite |
| ESA | European Space Agency |
| ESDIS | Earth Science Data and Information System |
| ESE | Earth Science Enterprise |
| ESSAAC | Earth Systems Science and Applications Advisory Committee |
| ETM | Enhanced Thematic Mapper |
| ETS | EOS Test System |
| EUMETSAT | European Organization for the Exploitation of Meteorological Satellites |
| FDS | Flight Dynamics System |
| FOD | Flight Operations Director |
| FOM | Facility Operations Manager |
| FOO | Flight of Opportunity |
| FOR | Flight Operations Review |
| FOS | Flight Operations Segment |
| FOT | Flight Operations Team |
| FOWG | Flight Operations Working Group |
| GCDIS | Global Change Data and Information System |
| GDS | ground data system |
| GEVS | General Environmental Verification Specification |
| GIS | Geospatial Information Systems |
| GMI | Goddard Management Instruction |
| GN | Ground Network |

| | |
|---|---|
| GPG | GSFC Procedures and Guidelines |
| GSFC | Goddard Space Flight Center |
| GSIF | Ground Station Interface Facility |
| HAIS | Hughes Applied Information Systems, Inc. |
| HDF | hierarchical data format |
| HIRDLS | High-Resolution Dynamics Limb Sounder |
| I&T | integration and test |
| IAS | image assessment system |
| ICC | Instrument Control Center |
| ICD | Interface Control Document |
| ICESat | ICE Satellite |
| ICSU | International Council of Scientific Unions |
| IGBP | International Geosphere-Biosphere Program |
| IGS | International Ground Station |
| IOT | Instrument Operations Team |
| IOWG | Instrument Operations Working Group |
| IP | international partner |
| IRD | interface requirements document |
| IST | Instrument Support Toolkit |
| IST | instrument support terminal |
| IT | Instrument Team |
| IV&V | independent verification and validation |
| IWG | Investigator Working Group |
| JPL | Jet Propulsion Laboratory (DAAC) |
| Landsat | Land Satellite |
| LPS | Landsat-7 Processing System |
| LTA | Long-Term Archive |
| LZPF | level zero processing facility |
| M&O | maintenance and operations |
| MCR | Management Coordination Review |
| MHS | Microwave Humidity Sounder |
| MISR | Multi-Angle Imaging Spectro-Radiometer |
| MITI | Ministry of International Trade and Industry (Japan) |
| MO&DSD | Mission Operations and Data Systems Directorate |
| MODIS | Moderate Resolution Imaging Spectroradiometer |
| MOPITT | Measurements of Pollution in the Troposphere |
| MOR | Mission Operations Review |
| MOU | memorandum of understanding |
| MPS | Multimode Portable Simulator |

| | |
|---|---|
| MSFC | Marshall Space Flight Center (DAAC) |
| MSR | Monthly Status Review |
| MTPE | Mission To Planet Earth |
| MTS | Manpower Tracking System |
| NASA | National Aeronautics and Space Administration |
| NASA HQ | NASA Headquarters |
| NASCOM | NASA Communications Network |
| NASDA | National Space Development Agency (Japan) |
| NCC | Network Control Center (GSFC) |
| NCEP | National Center for Environmental Prediction |
| NCR/CA | nonconformance report |
| NESDIS | National Environmental Satellite, Data, and Information Service (NOAA) |
| NHB | NASA Handbook |
| NI | NASA Internet |
| NISN | NASA Integrated Services Network |
| NMI | NASA Management Instruction |
| NOAA | National Oceanic and Atmospheric Administration |
| NPG | NASA Procedures and Guidelines |
| NSI | NASA Science Internet |
| NSIDC | National Snow and Ice Data Center (DAAC) |
| ODC | Other Data Center |
| OGC | Open GIS Consortium |
| ORR | Operational Readiness Review |
| PCA | Program Commitment Agreement |
| PCMB | Project Control Management Board |
| PG | Procedures and Guidelines |
| PI | principal investigator |
| POP | Program Operating Plan |
| PM | Project Manager |
| POES | polar-orbiting operational environmental satellite |
| PSLA | project service level agreement |
| PSR | Project Status Review |
| QA | Quality Assessment |
| QuikSCAT | Quick Scatterometer |
| RadarSat | Radar Satellite (Canada) |
| RRR | Release Readiness Review |
| SAA | Satellite Active Archive (NOAA) |
| SAM | System Assurance Manager |
| SAR | Synthetic Aperture Radar |

| | |
|---|---|
| SCF | science computing facility |
| SeaWiFS | Sea-Viewing Wide-Field Sensor |
| SeaWinds | Sea Winds |
| SEF | Sustaining Engineering Facility (EDOS) |
| SGS | Svalbard Ground Station |
| SI&T | system integration and test |
| SIPS | Science Investigator-led Processing System |
| SN | Space Network |
| SOMO | Space Operations Management Office |
| SOO | Science Operations Office |
| SOW | Statement of Work |
| SSDO | Science System Development Office |
| SSSWG | Storage Systems Standards Working Group |
| STS | Space Transportation System (Shuttle) |
| TDRS | Tracking and Data Relay Satellite |
| TDRSS | TDRS System |
| TES | Tropospheric Emission Spectrometer |
| TL | Team Leader |
| TRMM | Tropical Rainfall Measuring Mission (joint US-Japan) |
| TRR | Test Readiness Review |
| TSDIS | TRMM Science Data and Information System |
| TSS | TRMM Support System |
| TT&C | telemetry, tracking and command |
| U. S. | United States |
| UPN | unique project number |
| USGCRP | U. S. Global Change Research Program |
| USGS | U. S. Geological Survey |
| VIRS | Visible Infrared Scanner (TRMM) |
| WBS | work breakdown structure |
| WCRP | World Climate Research Program |
| WGISS | Working Group on Information Systems and Services |
| WMO | World Meteorological Organization |
| WRR | Western Range Regulations |
| ZIG | Z39.50 Implementor's Group |

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# APPENDIX B

## Applicable and Referenced Documents

ALERT Reporting of GSFC Parts and Materials Problems, GMI 5311.3C

Basic Safety Manual, NHB 1700.1 (V1-B)

Design Criteria for Controlling Stress Corrosion Cracking, MSFC-SPEC.522

Electrical, Electronic, and Electromechanical (EEE) Parts Management and Control Requirements for NASA Space Flight Programs, NHB 5300.4 (1F)

EOS Performance Assurance Requirements for General Instruments, 420-05-01

General Environmental Verification Specification for STS and ELV Payloads, Subsystems, and Components, General Environmental Verification Specification (GEVS)-SE

GSFC Health and Safety Program, GMI 1700.2C

GSFC Malfunction Reporting System, GMI 5311.1A

Guidelines for Standard Payload Assurance Requirements (SPAR) for GSFC Orbital Projects, SPAR-3

Major Systems Programs and Projects, NPG 7120.4

Materials Selection Guide; An Evaluation of Liquid and Grease Lubricants for Spacecraft Applications, TM 82276

NASA Software Documentation Standard, NASA-STD-2100-91

NASA Standard Electrical, Electronics, and Electromechanical Parts List, Military Standard (MIL-STD)-975

Outgassing Data for Selecting Spacecraft Materials, NASA Reference Publication 1124

Performance Assurance Requirements for the Common EOS Spacecraft, 420-05-04

Performance Assurance Requirements for the EOS AM Spacecraft, 420-05-02

Performance Assurance Requirements for the EOSDIS Core System (ECS), 420-05-03

Performance Assurance Requirements for the Independent Verification and Validation (IV&V) of the EOS Data and Information System (EOSDIS), 420-05-05

Quality Assurance Provisions for Delegated Government Agencies, NHB 5400.4 (2B)

Quality Program Provisions for Aeronautical and Space System Contractors, NHB 5300.4 (1B)

Reliability Program Provisions for Aeronautical and Space System Contractors, NHB 5300.4 (1A-1)

System Interface Control Plan for the ESDIS Project, 505-10-20

System Safety for Orbital Flight Projects, GMI 1700.3A

System Safety Program Requirements, MIL-STD-882C; and WRR 127-1

Western Range Regulation Range Safety Requirements, Western Range Regulation (WRR) 127-1